

Implementation of Smart Shopping System based on NFC Technology

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Abstract— The fusion of online and offline trading has become a significant pivot point of the Internet Era. Under the existing operation structure of supermarkets, this article aims to propose a Smart Shopping System based on NFC Technology. This system includes technical support of mobile applications, and users will be able to conduct a series of actions like product searching, pre-ordering and online payment on the mobile app. With NFC users can even pay the bills without credit card which would simplify the purchasing process. This article also proposed a corresponding management platform aiming to optimize the service and administration of the supermarket, which fits the emerging trend of O2O business mode.

Key words: NFC, Smart Shopping, Mobile Payment

I. INTRODUCTION

With the progress of economical situations, people now have more avenues to arrange their expenditures. Many would choose online shopping. However, it may bring loads of problems, a typical one being dissatisfaction with the goods. Meanwhile there are still traditional ways, yet it would consume much more time and energy.

These days NFC has gradually become a standard component of mobile terminals. Besides the mobile payment system, NFC technology can be integrated into other systems, such as access control, check-in system and security alarms. Take the access control system for example. First you need to authorize both the door control hardware and the mobile phone, then by placing your phone in the sensing area, you can gain access control. This simplifies the traditional procedure when an access card is needed additionally.

NFC (Near Field Communication) is a set of short distance wireless communication solutions based on RFID and internet technology. Any two mobile devices share the same NFC protocol will be able to automatically activate the communication system within 10cm and transfer data in a non-contact mode to complement functions like digital wallet or authentication systems. It operates within the radio frequency ISM band of 13.56 MHz on air interface and at rates ranging from 106 kbit/s to 424 kbit/s. It also supports other protocols including Bluetooth and 802.11 wireless specifications. NFC technology meets the international communication standards and has the potential to become a very competitive technology in short distance wireless connection territories.

This article is based on the combination of NFC and smart mobile terminals. With NFC smartphones can replace traditional credit cards and optimize the shopping experience, ultimately realizing a better service for customers.

II. BASIC INFORMATION OF THE SYSTEM

NFC generally has advantages including low costs, simple operations and high security, which indicates enormous possibilities in certain industries. This smart shopping system is an application of NFC aiming to implement mobile

payment. Apart from a more user-friendly shopping experience, it can also bring down the operation cost.

A. Software Structure

Figure 1 shows the software structure of the supermarket system.

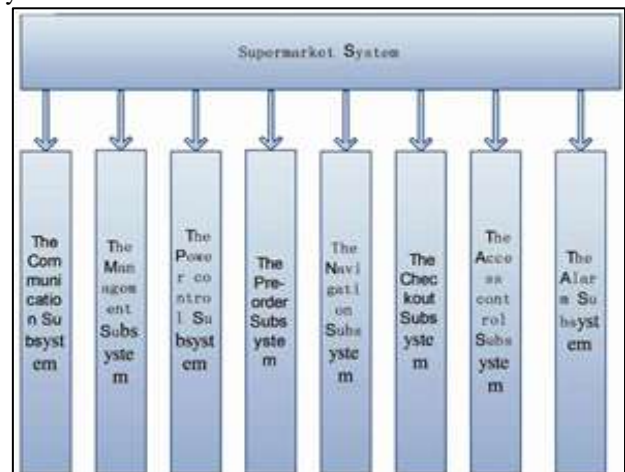


Fig. 1: The Software Structure of the Supermarket System

The system consists of the following divisions: the communication subsystem, the management subsystem, the power control subsystem, the pre-order subsystem, the navigation subsystem, the checkout subsystem, the access control subsystem and the alarm subsystem. The communication subsystem is built upon the combination of wired and wireless networks. Its main function is to coordinate the exchange of signals between multiple subsystems and communications with the cloud computing platform. The management subsystem is designed to handle procedures like the automations of inventory reports and marketing reports. The power control subsystem is set to balance the electrical load of the supermarket. The pre-order subsystem will answer all the online order requests from customers. The navigation subsystem is supposed to guide customers to locate the supermarket. The checkout subsystem and access control subsystem will function together at the cashier. The alarm subsystem will handle emergencies like goods stealing breakdowns.

B. The Purchase Process

Users will be able to search for product details in advance through the mobile app. Once they are logged in, they can also pre-order any products they want. If it is the first time the user comes to the supermarket, then he should register his personal information at the service counter. For users who already completed the registration, the system will match his account with the identity information automatically, so the whole process will only take place for one time. If the user has already pre-ordered certain products, he can directly come to the supermarket and check in at the NFC sensor of the entrance with his mobile phone. The system will transfer the total amount of money into a third party payment platform

from the credit card the user assigned. If the operation is successful, the user will receive an authorization code from the system on his mobile phone (with a period of validity that can be adjusted in real time according to particular situations). If the code matches the access control system, the entry will be granted. After the user get everything he need, he can check out with his mobile phone at the register and confirm the payment. The whole process is given as a flow chart in figure 2.

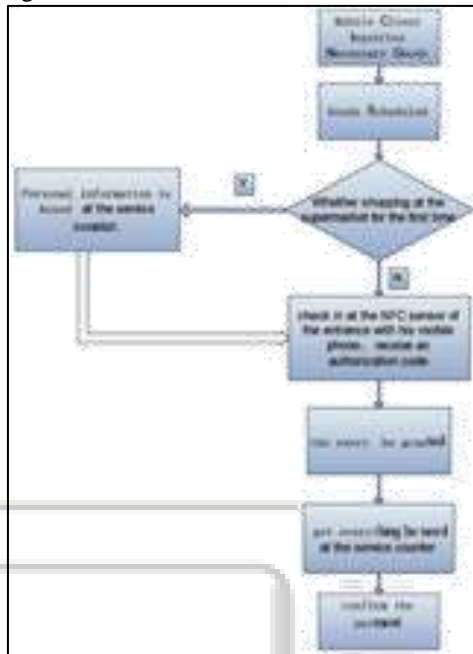


Fig. 2: The Whole Process

C. Refund Policy

When the customer has submitted the request of returning goods on the mobile client app, the system will inform correspondent service staff to identify the goods. If it meets the policy, the service staff can accept the request on authorized mobile devices and the system will activate the refund process with the third party payment account of the customer.

D. Navigation

The client app provides the geographical information of the supermarket, so customers will be advised with the best route by the navigation system on their phone.

III. IMPLEMENTATION OF THE SYSTEM

The whole system is developed with JavaEE and Android development platform and can be divided as two major parts: the web server system and the mobile client application.

A. Web Server System

The web server system deploys JAVA development environment including common framework technologies on different layers of web projects.

The Structure of the systematic web framework is shown in Figure 3.

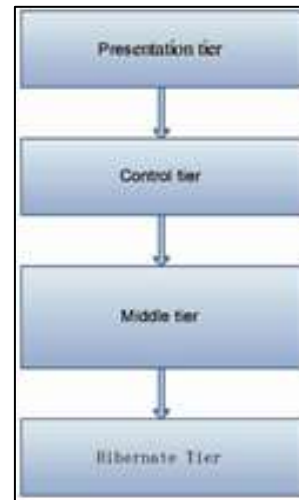


Fig. 3: The Structure of the Systematic Web Framework
As we can see, the entire system is constituted by four different layers:

1) Presentation Tier

Governed by ExtJs4. Specifically, ExtJs4 is responsible for the interface display. The interface is mainly constructed with JavaScript and Css technologies. With the arrangement of essential images, the exquisite interface could bring users appropriate visual impressions.

2) Control Tier

DWR of the Ajax technology is responsible for this tier. It can fetch the data from the user interface through ExtJs4 components on the presentation tier. Then it will transfer the data to the middle tier for operations without refreshment. Lastly it will notify the client app to call the callback functions and present the result to the user.

3) Middle Tier

Formed by Business logic classes and spring. The name of the Business logic class ends with Srv. First it interacts with the DWR, using the transferred input data of the DWR to process the business logic. Second it calls the Hibernate tier class to complete interactions with the database. Lastly it returns the results to the calling back function. All the relevant business logic classes are run by the Spring IOC containers.

4) Hibernate Tier

Formed by spring and Hibernate. The Business Logic classes of the Middle tier can call them to execute interactions with database. Hibernate take charge of the interactions with the database information through ORM mapping. Spring is responsible for the commanding of DAO (Data Access Object) Classes as well as the Session connections and Transaction control. This aims to simplify the application of Hibernate and improve the access performance with the utilization of the database connection pool.

B. Mobile Client Application

The mobile client application is developed with the Android 4.1 SDK. It deploys multiple threads in data interchange with the web server system in the format of Json. The results will be updated into the Activity through Handler.

As for the NFC access control subsystem, the mobile client app will first use the API provided by third party payment platforms to verify whether the user's balance is sufficient. If it is enough then the app will send a request to

the Web system to fetch the supermarket NFC authorization code. Using the SDK provided by NFC Manager through a provided NFC adapter case with the Bind and Service communications main program, the authorization code can be obtained through the NFC Adapter and it will match the NFC sensors.

IV. CHARACTERISTICS OF THE SYSTEM

The deployment of NFC technologies enables a mobile phone to serve as a payment device, allowing a shorter and more convenient shopping experience. The standard of the service has been improved while the supermarket can cut down its expenses on human labor.

O2O business model with the combination of offline activities with the Internet, the Internet now acts as the foreground of real life businesses, simplifying the accounting process. It should be also pointed out that O2O business mode can conduct intuitive statistical analyses and tracking evaluations, which is crucial in avoiding the unpredictability of promotional effectiveness in traditional commercial channels. O2O integrates the online orders with real life consumptions: every consumer behavior can be analyzed so that the supermarket will be offering ever improved services to the customers. In addition, by posting discount information and reservation privileges, the promotions and introductions of the supermarket can reach a large scope of Internet users, thus encouraging grouped purchase activities. Eventually these users can be converted into frequent customers.

V. CONCLUSIONS

A smart supermarket shopping system based on NFC should have advantages including high reliability, real-time interactions, convenience of installation and maintenance as well as high efficiency. However there is still a long way to go before it is widely put into use. The problems now focus on the superintendence of e-tags and lack of research in NFC terminals.

With the development of mobile communication technologies, the way of life will become more intelligent, the system of mobile payment will be ameliorated too. The future of NFC payment is still bright and the applications supporting NFC will continue to turn up with the maturation of the market.

In the near future, part of people's lives is certain to be occupied with widespread emergence of the NFC technology, particularly with respect to mobile payment. It is an industry worth continued attention.

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REFERENCES

[1] J. Pesonen, E. Horster, Near field communication technology. *Tourism Management Perspectives*, 2012(4):11-18.

- [2] Prinz, P. Menschner, Electronic data capture in healthcare--NFC as easy way for self-reported health status information, *Health Policy and Technology*, 2012(3):137-144.
- [3] Hohberger, R. Davis, Briggs Letal, Applying radio-frequency identification (RFID) technology in transfusion medicine. *Biologicals*, 2012, 40(3): 209-213.
- [4] Y. Zhijian, An Organizational Mode with Reputation for O2O E-Commerce, *Proceedings of the First Symposium on Aviation Maintenance and Management*, 2014, 2: 707-714.
- [5] Hasoo Eun, Hoonjung Lee, Heekuck Oh, Conditional privacy preserving security protocol for NFC applications, *Consumer Electronics, IEEE Transactions on*, 2013, 59(1): 153 – 160
- [6] Debiao He, Kumar, N., Jong-Hyouk Lee, Secure pseudonym-based near field communication protocol for the consumer internet of things, *Consumer Electronics, IEEE Transactions on*, 2015, 61(1): 56 – 62.