# Intelligent system applications in sales shopping assistance

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**Abstract** In Taiwan, numerous stores provide rewards points with which customers could earn rewards. Mostly the points were collected in the form of a rewards card. When a customer owns several or even dozens of rewards cards, this point collection system may become very annoying. Therefore, we decided to develop a new system to address this problem. Using mobile devices, such as smartphones or tablets, has become a common and popular phenomenon in modern life. Almost all the mobile devices are equipped with the Bluetooth technology and Global Positioning System (GPS). These two technologies were used in this study for our smart auxiliary shopping system. Instead of using 3G or Wi-Fi networks, users communicate data and geographic information through the Bluetooth Location Network (BLN) we constructed. BLN is a small wireless network formed by eight (at most) Android mobile devices with Bluetooth capability. Since the traditional Bluetooth connection mode cannot realize peer-to-peer (P2P) connection, we adopted BLN to shape a P2P network topology, which allows the designed system to implement fast data upload and download. The survey data showed the satisfaction rate for this system was as high as 81.5%, and 91.3% of people who owned smartphones were willing to install this system. These numbers prove that this system can provide users a more convenient and effective management platform for rewards points.

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## 1 Introduction

We are living in a rapid era, and convenience is indispensable for modern people. In Taiwan, the density of convenience stores is the highest in the world. According to the survey conducted by ACNielsen, averagely every person in Taiwan shops at convenience stores 15 times per month. It is obvious that Taiwanese people's demands for convenience stores cannot be ignored. In 2005, 7-Eleven, owned by the Uni-President Enterprises, first organized the point collection event, through which customers could earn Hello Kitty magnets. This event resulted in an astonishing 10% rise in their revenues. As a consequence, all kinds of stores in the service industry and restaurants begin to promote similar events that allow consumers to collect points for rewards. They hope that this marketing strategy could attract people to shop and indirectly increase the customer return rate.

As commercial strategies continue to evolve, coupons [1] or rewards points are common in Taiwanese stores (e.g., drink shops, eateries, and coffee shops) as ways to attract customers. However, consumers tend to miss the expiration date or lose rewards cards and points due to the increase in the number of cards and points. The loss of time, money, and the opportunity to collect the desired reward is definitely something to be regretted. In response, we developed a system that could be installed on Android mobile devices. This system digitalizes rewards cards, thereby reducing the changes of losing cards and points and reminding customers the expiration date. Also, this system prevents the costs for producing rewards cards and reduces the waste of green resources.

In recent years, cell phones have experienced an exponential growth. Cell phones evolve from a device only capable of making calls to the modern smartphones. Most people attribute the rapid development of cell phone technology to the advance in the wireless transmission technology. In addition, ABI Research predicts that the total value of mobile applications will amount to USD 25 billion in 2015 [2]. The highest proportion of cell phone operating systems is now occupied by the Android, which provides an open environment in which programmers feel easy to develop programs. This study proposed wireless network architecture, through which smartphones, with the help of Bluetooth short-range wireless communications network and GPS, established P2P connections with multiple mobile devices. This architecture allowed data transmission between various mobile devices.

A number of operating systems can be found in the current cell phone market, which includes Android, iOS, Windows Phone, Symbian, BlackBerry OS, and etc. Android has the largest market share among the global smartphone operating system market [3]. The most common operating systems in Taiwan are Android, iOS, and Windows Phone. Windows Phone is a smartphone operating system published by Microsoft on October 11, 2010. The interface of this system is created using a programming language known as "Metro," which tries to break the barrier between people and information. Windows Phone endeavors to create a cell phone interface that complies with ergonomics[4]. Android is a system

developed by Google. Compared to iOS, Android is an open platform [5][6]. Many of the source codes of Android have been published on the official website of Google for developers to reference and modify. Since Android accounts for a larger market share and is an open operating system that is easy to develop, this research based our development on Android.

Bluetooth is a technologydeveloped by Ericsson in 1994, which is almost 20 years from now. It is a mature wireless technology, and numerous studies have focused on Bluetooth applications. F.J. González-Castaño et al. used PDAs or handheld PCs compatible with Bluetooth as museum audio guide [7]. Although their system already supported multiple Bluetooth connections, it required a Bluetooth device to be the server, and clients were only allowed to communicate with the server rather than other client devices. E. Welsh, P. Murphy and P. Frantz shortened the connection time for fast-moving Bluetooth devices [8]. Although the connection time was shortened, connections were unable to be successfully established in every experiment. Several scholars proposed the integration of Bluetooth with other technologies to develop superior systems. For example, Siegemund, F and Florkemeier, C. applied the integration of RFID and Bluetooth to three practical systems and evaluated the appropriateness of these systems [9]. RFID is a wireless radio-frequency device. Active RFID is expensive, whereas passive RFID is cheap yet has an extremely short sensing range. Therefore, not all of their proposed systems were appropriate. In addition to restricted range, Bluetooth is not outstanding in its transmission rate. Thus, Uichin Lee et al. suggested the inclusion of P2P to increase the file transmission rate for Bluetooth devices [10]. Yet, due to the lack of a master as bridge, files were often sent to the wrong device.

In this study, we proposed a smart auxiliary shopping system, the purpose of which was to help the general public to mange the acquired points in a simpler and more convenient way. Moreover, promotion can be started with a lower cost, and there will be no longer card and sticker printing. Ordering time in restaurants can be saved, and non-restaurant stores could use this system to perform sales management and statistical analysis. This system enables point collection, notifications, cell phone GPS, and merchant information integration, which are convenient features for consumers to check nearby merchant data and information of rewards activities. Regarding merchants and restaurants, we implemented a point of sale (POS) system that notified customers that the food was ready after the food or products ordered by the customers were completed. This saved wait times and reduced wrong deliveries. The rest of this paper will be describe as the follows. In section 2. We will introduce the main part of our proposed system such as the transmittion among all Bluetooth devices. Insection3, we will show the results. Finally, we present conclusions and discussions.

## 2 Materials and Methods

The hardware architecture of the smart auxiliary shopping system is illustrated in Fig. 1. The entire system could be divided into three parts. The first part is the POS system, on which merchants select the products purchased by consumers and calculate the total price and amount as well as the points for the consumers. The second part is the Bluetooth device, which serves as a medium for sending and receiving points as well as redeeming rewards. Moreover, the third part displays merchant information on Google Maps, so consumers could see the information of their nearby merchants.


**Fig. 1** Our proposed system architecture

Intelligent Assistance Sales and Shopping System divided into two parts. One is Server App. The other is client App. We will introduce these two parts as the folleows in detailed.

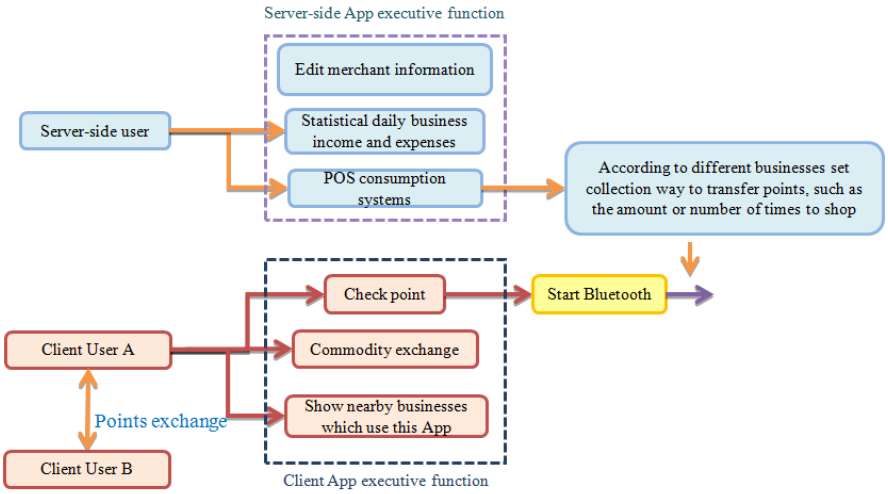


**Fig. 2** The processing flow chart of our proposed system

## *2.1 Functions of the Server Application:*

The server contains a POS system that helps store owners manage their sales. The POS proposed in this study is different from a typical POS system, which can only be developed after the POS company conducts demand analyses for stores. Using the proposed the system, merchants are able to enter their products into the database. Once the database is set up, their products are ready for sale. All data are stored in the database located on the mobile server; therefore, merchants of all types can create a customized POS system that suits their demands. This system displays the sales status for all kinds of products, real-time inventories, and statistical analysis reports. The displayed data familiarize merchants with all various statistical analysis reports, including daily revenue, net profits, and price analysis. Moreover, merchants are able to employ the optimal marketing management strategy to obtain the latest sales status.

Additionally, the server application transmits points through Bluetooth connections. After the proper payment process, the server will search for the nearest Bluetooth device from the server mobile device. After the name is verified, points and geographic data are then sent to the client. Moreover, when the client Bluetooth device is connected, all transmitted data are encrypted to protect the right of merchants. Fig. 3 shows the condition when multiple clients simultaneously open the client application. There will be one server and multiple clients.


**Fig. 3** The architecture of Bluetooth Location Network

Subsequently, all these devices form a BLN, and we need to figure out which client is carrying out transactions with the server. Due to the fact that regardless of the type of transactions (cash or credit card), the client would have to be close to the checkout, we assumed that the client who was closest to the server was making transactions. Since the strength of Bluetooth signals varies according to the distance, the received signal strength indication (RSSI) between the server and client has to be calculated. RSSI is a distance measurement method. During transmission, wireless signals may be interfered by many factors. Equation (1) shows the relationship between RSSI and reception distance:

$$\mathrm{RSSI} = -(10 * \mathrm{n} * \log_{10} \mathrm{d} + \mathrm{A}) \tag{1}$$

where n is the transmission coefficient, d the distance, and A the signal strength received with a distance of one meter. The distance can be calculated by (2) when RSSI, A, and n are given:

$$\mathrm{d} = \left(10^{|\mathrm{RSSI}|-\mathrm{A}}/(10 * \mathrm{n})\right) \tag{2}$$

The advantage of RSSI is its easy accessibility because the RF chip would handle signal reception and conversion. The user only has to program the codes of RSSI to add relevant values to the transmission packets. Calculations of RSSI from the receiver's side would yield the result of distance. With RSSI, the distance between the server and all clients can be obtained to determine the devices that are conducting transactions. Therefore, transactions will not be conducted with the wrong mobile devices.

### *2.2 Executing Functions of the Client Application*:

The client application automatically shows nearby merchants using the same server application. The system marks all the stores that use the proposed server application on Google Maps. Users could take a look at store information simply by clicking the store icon. The system proposed in this study does not require 3G or Wi-Fi networks, and therefore the server is unable to upload geographic data to show distant clients the server location. Our solution is as follows: When a client enters a store utilizing the same system, the geographic data of the store are automatically imported into the database as soon as the connection between client and server is established. If there is a new user who does not possess the geographic data of the store, any mobile device within the reach of Bluetooth transmission distances and containing the data will send the data automatically through Bluetooth to the new user. If there are six mobile devices using the proposed system around Store A, these devices transmit store geographic data in their databases to each other and save the received geographic data. This method will increase the amount of stores displayed on Google Maps as the number of users continues to rise.

Point trade or exchange is made possible through Bluetooth communications, and users can bring sufficient rewards points to stores equipped with the server application to redeem the reward.

The smart auxiliary shopping system is based on a concept contrary to the traditional rewards program. One mobile device can be the vehicle of rewards cards of numerous stores, eliminates the inconvenience of bringing a stack of cards, and helps consumers collect points without burden.

## 1.3 Experimental Results

We use Android platform as the platform od our proposed system.It is a popular OS. And, the Eclipse software are used to develop our system. The HTC One X is used as our development tool. The detailed specificatim of HTC One X.

Fig. 4 shows the POS screen of the proposed server application. In the screen is the number and price of items. The cashier could know at a glance what the

customer buy and enter the correct price. The system will judge by itself whether changes are needed. After the transaction, the system stores the detail of the transaction as sales statistical data. The item name and price on the screen can be determined by the merchant and be saved to the database. Thus, stores of any kind can establish a unique menu using this system. However, rewards programs are not available in all stores.

Fig. 4 The UI for checking out

Fig. 5 The UI for collecting point

If the transaction amount is lower than the minimum value of the rewards program, the same notification shows up after the transaction (Fig. 5).

Bluetooth must be open if points are to be given to the customer. When both the customer and the store turn on the Bluetooth function, the server will be able to scan all Bluetooth devices nearby and calculate their RSSI values. Therefore, employees see clearly the closest device, to which points can be given, as shown in Fig. 6.

The geographic data of stores will be stored in the databases of general users. As shown in Fig. 7, store locations appear when Google Maps is open. If more stores adopt this system, more stores can be marked on Google Maps, and users could find the store they need more rapidly. Consequently, the customer return rate for all stores can be increased.

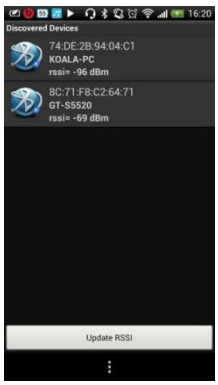


Fig. 6 The UI of RSSI of Bluetooth device

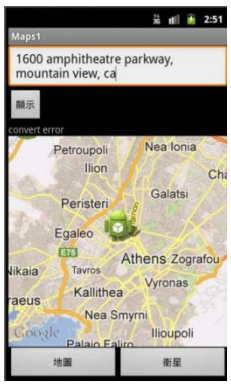


Fig. 7 The UI shows the store position using our proposed system

Developed on Android, this application can be installed on numerous cell phones using the Android system architecture. The proposed application is neither restricted to phone types, nor to phone brands. All Android smartphones can benefit from this system. We invited volunteers randomly on streets to test the

system, and conducted questionnaire surveys to measure user satisfaction and application reliability. According to the statistics, user satisfaction reached approximately 81.5%, and 91.3% of the participants who owned smartphones were willing to install this system on their phones. Most participants reported that this was a speedy and convenient system.

## 1.4 Conclusions

Bluetooth is a technology that has been developed for almost 20 years. A number of scholars proposed products or concepts that integrated Bluetooth with various devices or technologies. This system utilizes the built-in Bluetooth and GPS functionalities to assist sores in implementing marketing management with more convenience. Also, additional equipment is not required, as existing mobile devices can benefit from this system. Consumers who possess this system could utilize it to reduce the chances of forgetting the rewards card or coupon somewhere or nor remembering the expiration dates, which in fact are losses of their interests. A complete shopping network can be built and this system can be further improved when a considerable amount of stores and users begin to adopt this system.

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