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More Precise: Stores Recommendation under O2O Commerce

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Abstract: With the popularity of online shopping, Online to Offline (O2O) commerce is a newly business model between company and customers. Online to Offline (O2O) commerce means customers can order some services or products online, and then they go to the corresponding stores to take the services or products. How to recommend useful and precise advertisement for customers is very important under Online to Offline (O2O) commerce environment. If the recommendation work is down well, it will attract more customers to pay online and then get the related products in the real-world stores (offline). In this paper, we proposed a methodology based on the Back Propagation Neural Network algorithm to recommend some real-world stores information for travelers according to their current status such as location, time and budget. Basically, when travelers go to another unfamiliar city, they can download the store recommendations APP by their mobile devices to get the information which is needed by travelers. Furthermore, the results are more precise and close to travelers' desires and current status.

Keywords: online to offline, O2O, recommendation system, neural network

1. INTRODUCTION

Due to the network technology that has advanced at an astounding speed, businesses can get more advantages by using network marketing strategies: such as propose advertisements on the network to attract more potential customers at anytime and anywhere. According to Michael Delpierre, Chief Executive Officer and Chief Marketer for Conversion Pipeline (A leading Online Marketing Agency), there are seven trends for network marketing in 2013. Some of the important trends includes: "Deals, Deals, and More Deals", "Go Mobile", "Online Advertising", "Go Local or Go Home" [1]. In other words, more and more customers will search for information, products and services online for convenience. If company can provide more attractive deals online, they will gain more customers and keep the customer loyalty.

With the popularity of mobile devices and mobile communication technologies, people have more demands on services online. Google also had done a research about what customers will do with their smart-phones. The result in Figure 1 [2] shows that more than 50% of users do purchase activities by smart-phones online or in-store. At the same time, company must reconsider how to let customers shop online by their mobile devices more conveniently and efficiently. Furthermore, company must provide services or products according to where the customers are located. In other words, company can utilize the Global Positioning System (GPS) to locate and search the proper advertisement recommendations for customers.

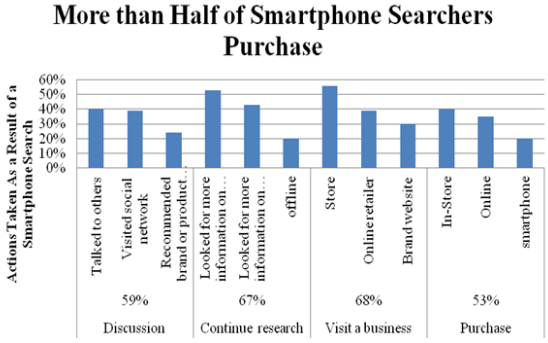

Figure 1. What will customers do with their smartphone? [2]

In order to gain more revenue for company and to increase the immense satisfaction for customers, it is very important to propose a useful network marketing strategy. This strategy will bring advantage for both company and customers. However, according to the number proposed by Alex Rampel [3] who is the co-founder and Chief executive officer of TrialPay, customers only spend their money on e-commerce with 8 % of their earning. He proposed an example: The shopper spends about $1,000 per year online while the average American earns about $40,000 per year, how about the other $39,000? The answer is that most of the earning is spent locally (In-store shopping). People usually spend money at coffee shops, gyms, restaurants, and hair salons at etc. Based on this result, online to offline (O2O) commerce becomes a new opportunity for company to gain revenues.

After the Groupon website (The name of Groupon is derived from "group coupon" and it is a deal-of-the-day website that features discounted gift certificates usable at local or national companies) was launched, the concept of O2O induce researchers to propose more marketing strategies under this brand new commerce environment. Basically, the concept of O2O is that customers order some products or services online and then the customers go to the real-world stores to take the products or services. The process of O2O commerce combine payment model and foot traffic generator for merchants, and is also called a "discovery" mechanisms for consumers. This commerce model will also create offline purchases. Furthermore, according to a study conducted by Pew Research Center [4], there are 58% of all American adults who perform online research on the services or product they consider to purchase. Besides, nearly 67% of people said they usually use smart-phones for product research and then they will purchase the items in a real-world store.

To sum up, the overall O2O commerce includes three essential factors: real-world store recommendation, online payment and outcome monitor [3] [5] [6]. Among these, it is important to recommend useful and touchable stores for customers. Up to now, there are two methods to help customers get the information about the real-world stores [7]. The first method is providing coupon to customers. This can attract customer to consume via price decreasing. The second method is "search". In this method, people usually don't know what to buy at a certain time or place. The service system can provide customer a way for searching and recommending the popular or useful products. If the system can provide the related products usefully and precisely, it is more easily to keep the loyalty of the customer, and then gain more revenues.

In order to recommend the product more precisely, a method, which is combined with the Artificial Neural Network (ANN) algorithm is proposed. Through the proposed recommendation application system, travelers can input some basic data to the system. The system can compute the related data and then provide some store recommendations. This is more useful, precise and convenient for travelers when they come to an unfamiliar place and don't know what to purchase.

Here, the related concepts of neural networks are introduced in Section 2. The proposed methodology and experiment results are described in Section 3. Finally, Section 4 gives the conclusion.

2. THE CONCEPTS OF NEURAL NETWORK

An Artificial Neural Network (ANN) [8] [9] [10] [11] [12] [13] [14] is an information processing model which is inspired by the way biological nervous systems. The key component of this model is the structure of the information processing system, which is composed of a large number of highly interconnected processing elements working together to solve specific problems. ANN can learn by examples like people do. It is usually applied for specific applications, such as data classification, decision making, prediction or pattern recognition.

The main concept of ANN is to find a relation model between input data and output data. This model will then be used for some works, in which are unknown and needed some decision making.

In the past, there are lots of ANN algorithms been proposed to help predict some trends or future events. Back Propagation Neural Network (BPNN) [15] [16] [17] [18] algorithm is one of the famous algorithms.

Basically, BPNN algorithm contains two processes, which are the learning process and the recall process. In the learning process, the system will keep learning and computing based on the network settings for adjusting the weight of the connection. Users can input the needed data into the system, and the system will recall the algorithm and then keep computing. Finally, the system will output the related results. The overall structure of BPNN algorithm is shown in Figure 2 and the basic function is shown in Equation (1).

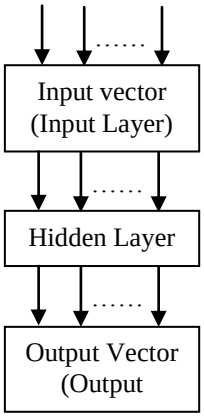

Figure 2. The structure of BPNN algorithm.

$$Yj = f(\Sigma(Wij * Xi + b)) \quad \cdot \quad Equation\ (1)\ [15]$$

The meanings of the notations included in Equation (1) are listed as follow:

- Y_j: The output vector
- f: The BPNN function
- X_i: The input vector
- W_{ij}: The Weight
- b: The Bias.

To sum up, BPNN algorithm has the property and advantages of learning and recalling previous training data while doing some prediction, such as adaptive learning, self-organization, real-time operation, and fault tolerance via redundant information coding. This is why it is applied for many applications often. In order to improve the precision of the real-store recommendation for travelers, the proposed system will combined the BPNN algorithm, and the detail methodology is introduced as following Section.

3. METHODOLOGY AND EXPERIMENT RESULTS

In this paper, we proposed a methodology for improving the precision of real-world store recommendation based on BPNN algorithm under O2O commerce. We also develop a mobile application (also called APP) for users to search for the useful results.

A. Circumstance

In order to help understanding the overall process for getting useful recommendations, a circumstance is applied in this paper that is happened when the travelers visit a foreign city or country. Most of the travelers may have no idea about what to eat for meals. They can see in the APP system through their smart-phones. There has one condition been considered: the GPS function is enabled or disabled? If it is enabled, user must select the budget for meal. On the other hands, user must select the location they want to precede their consumption. After that, the data about location, time and budget will then be used for the recommendation system. The system will compute and recall data from database by the BPNN algorithm. Finally, travelers will get first five top real-world restaurants, where all restaurants have the cooperation relationship with the system, and will give users some discounts or promotion. Travelers can read the details of each restaurant. If travelers select one of these five restaurants, they can pay online in advanced. When they go to the real-world restaurants, they can eat the meal without pay anymore. Basically, the system will not only recommend real-world restaurants, but also gyms, coffee shops, hair salons at etc. The overall of the processes is shown in Figure 3.

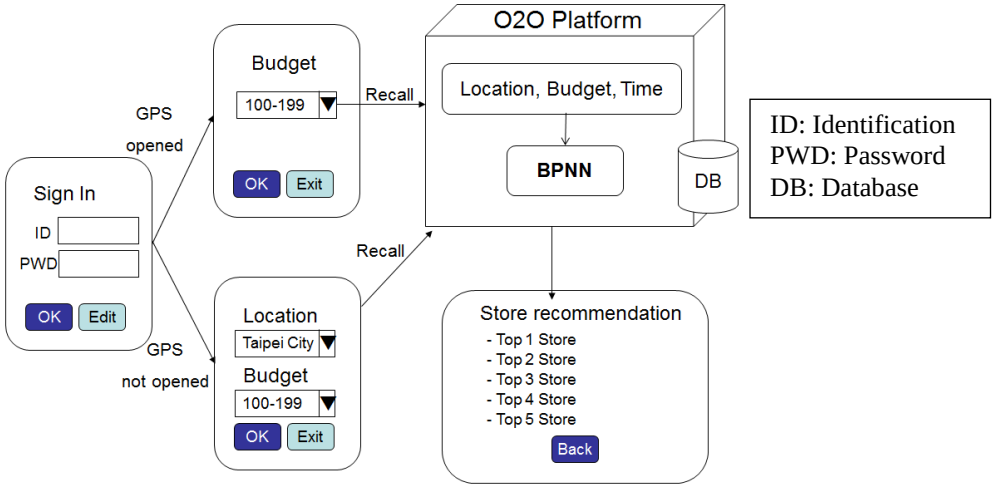

Figure 3. The recommendation process.

B. Data collectionss

In order to collect users consumption behaviors legally, the proposed system will use the open data provided by Taipei city and New Taipei city in Taiwan [19] [20]. These two websites provide all kinds of information about restaurants, movie theaters, salon at etc. For the beginning of the experiment, the system will focus on the real-world restaurants only.

C. Input data and output data normalization

For learning process in BPNN algorithm, how to translate the open data into the input vector and the output vector to be readable for BPNN algorithm should be considered first. Basically, the proposed system will only require three kinds of data for the learning process that are budget inputted by travelers, the current time of consumption obtained by smart-phones and the location information of travelers which is gained by enabling GPS function on smart-phones. Here, these three types of data will be converted into binary information sequences. Note that, the overall information is listed in Table Ⅰ. The related bits for learning the data are listed as the following example in Figure 4. Assume that a traveler wants to decide real-world restaurant at 16:30, and the current location shown with GPS is (24.000001, 121.000001) which represent the latitude and the longitude respectively. After converting the data into binary sequence, the final input vector will be list as Figure 4.

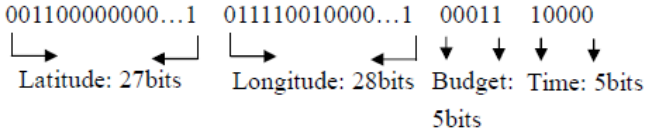

Figure 4. An example of an input vector.

TABLE I. THE CONVERSION INFORMATION ABOUT THE INPUT VECTOR.

	Bits	Original data		Binary sequence
GPS_latitude	27	24.000001		001100000000…1 (Total: 27bits)
GPS_longitude	28	121.000001		0111100100000…1 (Total: 28bits)
Budget (NTD)	5	0	0~99	399→class 3→00011
		1	100~199	
		2	200~299	
		…		
		31	3100~3999	

Time_hour	5	0	0:00~0:59	16:30→class16→10000
		1	1:00~1:59	
		2	2:00~2:59	
		…		
		23	23:00~23:59	

Currently, the proposed system can collect up to 1024 real-world restaurants, and each of them will be assigned a unique identification (ID). Consequently, the output vector will need 10 bits of a binary information sequence. Basically, only the ID of each real-world restaurant is needed to be input into the proposed system while learning process. The detail information about the real-world restaurants such as the name, location or promotion activities of the store do not need to be learned in the learning process.

The mapping process while learning is shown as Figure 5.

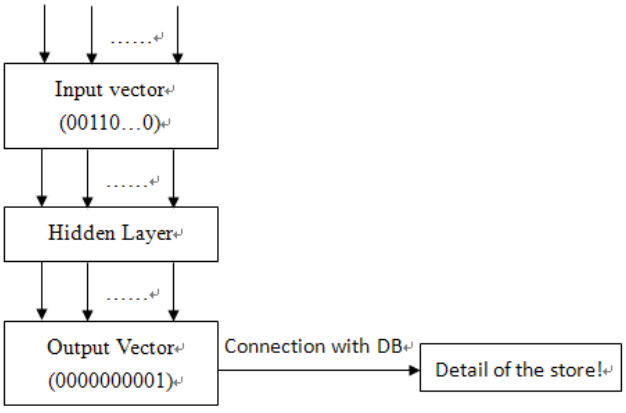

Figure 5. The mapping process.

After finishing learning process, the proposed system can recommend the top five suitable real-world restaurants computed from the recall process for travelers, and the travelers can select any one of the restaurants for consumption.

D. Experiment results

For the client side, an APP, named as Pleasure Agent, is applied by the above-mentioned recommendation scheme. Pleasure Agent is developed under the Android operation system whose version is 2.3.3.

Basically, the data, obtained from open data which are provided by Taipei city and New Taipei City, must be learned through the BPNN algorithm by the server. The learning frequency depends on whether the open data is update or not. This can decrease the loading for both side of server and smart-phone of the travelers. Besides, after the learning process, we also input five test data to observe the related results.

Table Ⅱ shows the detail information of the five sets of test data. For example, in the first set of test data, we select the budget within the range of 1 to 99 at 7:30 in the morning. Besides, the position shown on GPS system is (25.03456765, 121.5156785). After clicking the submit button, Pleasure Agent responses the related information of the first 10 real-world stores. As shown in Table Ⅲ, for the first set of test data, the ID of top one store is 147, and its probability is 0.050419. Basically, this probability, which is the number, computed by the BANN algorithm, means that most 5% of people will choice this real-world store for consumptions at the similar condition with the user's input requirement. Table Ⅲ shows the detail probability for the first 10 real-world stores for the first set of test data. Same as the first set of test data, we test extra four sets of data to observe the recommendation results. Based on the test data shown in Table Ⅱ, the recommendation results are also shown in Table Ⅲ. Figure 6 shows the related chart of the simulation results of the five sets of test data. Here, the x-axis represents the store ID, and the y-axis represents the probability of store that users may be interested in. Here, the peak of each line chart is the top one store. After getting the store name (Pleasure Agent system will transfer the ID into the store's name), travelers can click on the item they are interested in. The system will show more detail information of the selected store, and help travelers to precede consumption or payment activities. Here, the related simulation diagrams are shown as Figure 7 to Figure 10.

Up to now, the overall Pleasure Agent system has been constructed, and Figure 11 to Figure 13 show the real diagram of the processor while executing the Pleasure Agent system.

TABLE II. THE FIVE SETS OF TEST DATA:

	1'st set	2'rd set	3'rd set	4th set	5th set
Time	07:35	08:05	12:05	16:16	20:40
Longitude	25.03456765	25.123455	25.1456	25.34568546	25.2257646
Latitude	121.5156785	121.526543	121.2675678	121.2987654	121.1234654
Budget	1-99	100-199	400-499	300-399	500-599

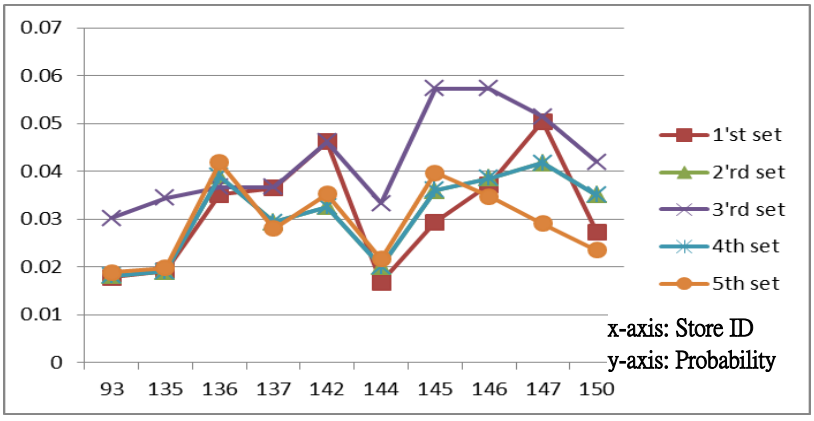

Figure 6. The recommendation results of the test data

TABLE III. THE DETAIL NUMBERS OF THE RECOMMENDATION RESULTS OF THE TEST DATA

	1'st set		2'rd set		3'rd set		4th set		5th set	
	Store ID	**Probability**	**Store ID**	**Probability**	**Store ID**	**Probability**	**Store ID**	**Probability**	**Store ID**	**Probability**
Top 01	147	0.050419	147	0.041701	146	0.057315	147	0.041703	136	0.041843
Top 02	142	0.046183	136	0.038952	145	0.057267	136	0.038964	145	0.039679
Top 03	146	0.037137	146	0.038538	147	0.051440	146	0.038540	142	0.035266
Top 04	137	0.036464	145	0.035986	142	0.046168	145	0.035993	146	0.034755
Top 05	136	0.035114	150	0.034989	150	0.041918	150	0.034991	147	0.029049
Top 06	145	0.029375	142	0.032581	137	0.036679	142	0.032587	137	0.027967
Top 07	150	0.027291	137	0.029336	136	0.036657	137	0.029343	150	0.023422
Top 08	135	0.019122	144	0.020092	135	0.034442	144	0.020096	144	0.021596
Top 09	93	0.017764	135	0.018986	144	0.033301	135	0.018991	135	0.019718
Top 10	144	0.016723	93	0.018082	93	0.030135	93	0.018087	93	0.018779

Figure 7. The diagram of signing in to the system

Figure 8. Selecting the budget when the GPS function is enabled.

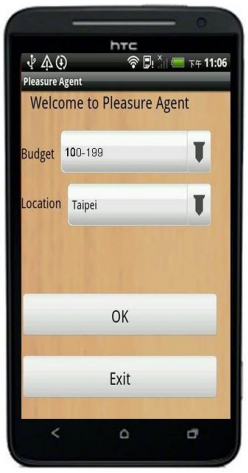

Figure 9. Selecting the budget and location when the GPS function is disable.

Figure 10. The recommendation results.

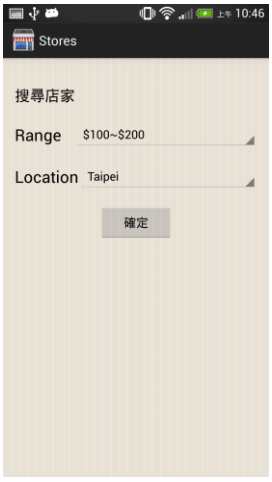

Figure 11. Travelers input the budget and location with GPS function off.

Figure 12. Pleasure Agent system provide the recommendations.

Figure 13. Showing the detail information of the real-world store.

4. CONCLUSION

According to Alex Rampel, most people in the USA spend 92% of their earning on real-world stores. Besides, there are 53% of people who use their smart-phones on purchase online. Based on these two statistics, a new concept called O2O (online to offline) commerce had been proposed. In order to gain more revenues for business, it is very important to propose a methodology to recommend a precise and useful real-world stores information for users. Through the recommendation system, users can select a preferable real-world store, order services and pay money online. When they have time, they can go to the store to precede the consumption without paying anymore. This will create a win-win situation for both company and customers. In this paper, we proposed a methodology based on neural network algorithm to improve the precision of recommendation results. We also design an APP system based on Android system. The proposed system will provide the first ten of suitable products for users. According to the outcome derived from BPNN algorithm, the recommendations are more precise. After getting the recommendations, users can shop and pay online, and then go to the store to get their products or enjoy their ordered services.

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