On Factors Affecting the WeChat Design Based on Neural Network

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Abstract—WeChat (known as Weixin in Chinese) has improved the contact interface of many businesses. So, the identification of critical factors influencing the WeChat design is very important. By combining questionnaire investigation and a neural network, this paper analyzes a variety of variables in an attempt to identify the accurate predictors of WeChat adoption. The results of the analysis show that eight variables are the important factors that should influence customer's purchase intention on WeChat. Therefore, WeChat designer should consider these contextual factors in order to optimize the mobile app design.

Keywords—WeChat; mobile app; neural network; consumer behavior

I.   INTRODUCTION

The original version of WeChat was released by Tencent in January of 2011 and quickly grew by leaps and bounds. The service gradually added platforms until it is now supported by iOS, Android, Symbian, Windows Phone and BlackBerry on Wi-Fi and every network between 2G and 4G, and it is also available in a number of languages including English, Indonesian, Korean, Hindi, Thai, Vietnamese, Malay, Japanese, Turkish, Arabic, Spanish, Portuguese, Italian, French, Polish, Russian, and of course traditional and simplified Chinese. The penetration rate of WeChat in China is massive, with over 90 percent of all smartphones in the nation using it, often with daily activity, which can only be called intensive [1]. With more than 600 million users registering, WeChat is quickly becoming one of Asia's primary social networks with a massive presence not only in China but also India, Thailand and Malaysia.

WeChat is regarded as an excellent virtual platform for businesses to reach potential customers. Unfortunately, many WeChat shops have a short life because of ignoring customer behavior so as not to meet the minimal demands of consumer. It is obvious that customer experience is one of the critical factors for the WeChat shop's success. So, in the WeChat design, ranging from dynamic Web content presentation, personalized ad targeting, to individual recommendations to the customers, it is very important to discover some sets of rules about individual user behavior [2]. For example, the design of retailer WeChat website should pay more attention to catering to the needs of repeat customers by offering them more personalized services.

As one kind of popular messaging app, WeChat is slowly turning itself into an advertising platform that will radically change the traditional way of engaging market. Taking e-commerce as an example, organizations can make full use of its powerful computing and communications ability to streamline their business processes, enhance customer service and offer digital products and services [3]. However, WeChat must attract the user's attention enough to excite buyer passions and purchase the advertise products. To achieve the goal, app designers need to identify the users' characteristics. For example, users are men or women who prefer to browse WeChat shops to find their needs. Statistically, half of the potential buyers of the app are female, but the Webchat app design is still a male-oriented environment. So, the understanding of gender differences had become one of the most popular divisions used by theoretical circles and enterprises for gathering information, providing products and market segmentation.

Many of sellers online could not find sustainable profitability model to face the situation that the percentage of buyers online is declining. So, more and more attention has been put on that identifies as many factors as possible that affect an individual's adoption of WeChat and firms are thinking what should be taken to optimize the design of WeChat app. In fact, the customer's attitude on a WeChat shopping correlates nonlinearly with the design based factors. Therefore, if the weight of WeChat design factors is identified, a proper model finding technique for customer's adoption prediction is essential. A general method most commonly used by researchers was statistical model. The dataset relating to customer's characteristic of buying online is essentially nonlinear, so, the neural network techniques, that are applicable to information processing methods used in the complex question, would be a better choice [4]. The approach has the advantages of nonlinear, input-output mapping, adaptivity, generalization, and fault tolerance [5].

Neuronal network is not full reconstructions of any cognitive systems which was found in the human brain, and are therefore unlikely to form a complete representation of human perception. Some researchers argue that human perception must be studied as a whole; hence, the system cannot be taken apart and studied without destroying its original functionality. Furthermore, there is evidence that shows cognition is gained through a well-orchestrated barrage of sub-threshold synaptic activity throughout the network. So, this paper is organized as follows. We first review some important results in website

design and the factors about online shopping in chapter 2. The methodology of survey research and neural network method used in this study constitutes chapter 3. We then present results of a data analysis, followed by implications, limitation and the future direction.

II. LITERATURE REVIEW

What could encourage him to change his traditional consumption pattern? It is cheaper prices, faster transactions, one-stop-shopping, availability, positive experiences or added services. In IS adoption area, researchers have always made many efforts to find the related theories for examining the determinant factors of information technology acceptance. It is in such situation that the technology acceptance model (TAM) was developed gradually to explain and predict IT adoption and facilitate software design before users have experience with a system. TAM surmises user technology adoption based on two specific behavioral assumptions: perceived ease of use (PEU) and perceived usefulness (PU) [6].

In E-commerce design area, previous research considered the design and preparation of website system with respect to gender issues. The role of gender in bloggers' switching behavior that depends on three factors: satisfaction, sunk costs and attractive alternatives. This study showed that female was more sensitive to satisfaction and fewer tendencies to attractive alternatives than male. Male preferred usefulness of technology, and female done ease of use. From web design perspective, men were more sensitive to the symmetry effect and reacted negatively to asymmetrically design websites, however women were not influenced by symmetry. Yuan (2013) argued that selection of graphics, design of interface, and all these visual factors would influence and possibly change the users' online purchase [7].

Moreover, some researchers investigated the high dropout rate (discontinuing online shopping once initial purchases took place) among online shoppers. Some result related to this phenomenon showed that the factors influencing online purchase include experience with online shopping, enough time of surfing net at home, usage of Internet for information services and a significant reliance on e-mail, that all increases the likelihood of spending online. Consumers without these characteristics were found to be much less likely to be repeat purchasers by E-commerce website. The characteristics listed above point to general factors of the individual's experience, location, and purpose as important for e-commerce marketing success. In addition, the practical level of users was also found to be a factor contributing to the level and frequency of online purchases. Online consumers with more than three years online experience were found to be almost twice as likely to make online purchases as those with few Internet experience. Further, the value of purchases made by experienced users during a three-month period was more than twice that made by inexperienced users. In general, years of Internet purchase experience also appeared to be associated with average weekly hours of surfing net. With the aid of survey research and a neural network, people found that gender, overall computer usage, job-related use and home access as important characteristics would influence online shopping.

In a recent study, experience level, and confidence in the security of network were found to influence the level and frequency of online shopping. These factors are still important as more recent studies attest [8]. Among northern American users, nearly half of those who have made purchases online are at least somewhat concerned about security, and about 99 percent of all Americans who have been using the Internet for less than one year are at least somewhat concerned about security. Other important factors related to online usage include ease of use and usefulness. Although all such research is primarily descriptive and demographic in nature, lacking the application of advanced statistical analyses as part of their design, some findings about the nature of online shopping may be gained from some reviews. Online purchase has enabled E-commerce transactions and generated large-scale valuable data. So, technology with data mining would begin to be used to understand these plentiful of data sets. AI and database succeed on the application of online marketing, such as customer profiling, recommendation systems, web personalization and so on.

III. DATA COLLECTION AND ALGORITHM

A. Data Collection

Based on the present research of influence factors about e-commerce, a survey was constructed to explore these potential determinants that affect the design of WeChat app, including age, gender, location for WeChat, purpose for using the WeChat and so on. To ensure content validity, the instrument was pilot tested on several faculties who teach E-commerce design and application, and data collection came from ten classes of 528 university students that are often engaged in WeChat shopping. As the students in various sections of IT courses were encouraged by their instructors to complete the survey, the response rate reached 100 percent. Respondents to the survey were either freshmen enrolled in a required web course (25 percent), sophomore business majors enrolled in a required intermediate web design course (30 percent), senior business majors (non-IS majors) enrolled in an E-commerce course (21 percent), or junior IS majors enrolled in various required web design courses (24 percent). Of the 528 students who completed the survey, 43 percent were at least 22 years old and 57 percent were age 18-21. With respect to gender, 58 percent were male and 42 percent were female. A total of 52 percent of the respondents were business majors (non-IS), 25 percent were non-business majors, 26 percent were IS majors.

More than 92 percent of respondents reported using the WeChat from one to four hours per day. The survey shows that a majority has at least ten years of surfing Internet experience and use the Internet no less than two hours per day. 95 percent of respondents indicated they browse the Web on a daily basis. Table 1 lists all the objectives mentioned by the respondents. The objective scenes put forward by the respondents were in great abundance. To a certain extent, the situation reflects how people are using WeChat in daily life. Respondents stated that they are nearly equally likely to use the WeChat at either home or school.

B. Algorithm of Neural Networks

A neural network is composed of a lot of nodes, or units, which are connected to build relationships with each other by links. Each of these links has a numeric weight associated with itself. Some of the units that are connected to the external environment would be designated as input or output units. The weights would be adjusted according to the inputs and outputs so as to make the network's input/output behavior more into line with that of the environment. To build a right neural network to perform the task in this paper, we firstly decide how many units are used, and what kind of units is appropriate, as well as how the units are connected to form a network. Furthermore, we would initialize the weights of the network, and trains the weights using a learning algorithm.

TABLE I. SCENES MENTIONED BY THE RESPONDENTS

No	Objective scenes
1	Chatting with friends
2	Chatting with colleagues
3	Browsing the circle of friends
4	Meeting new friends
5	Managing WeChat stores
6	Buying products
7	Browsing subscription news
8	Buying airline tickets and other tickets

Back Propagation is a gradient-based search algorithm that creates limitations on finding the global or best solution. In the perceptron learning process, we try to minimize the error between each target output and the output actually gained by the network. At the output layer, the weight updating rule is very similar to the rule for the perceptron. The activation of the hidden unit a_j is used instead of the input value, and the rule contains a term for the gradient of the activation function. If Er_i is the error (T_i-O_i) at the output node, then the weight updating rule for the link from unit j to unit i is

$$W_{Ji} < -W_{jI} + \alpha \times a_j \times Er_i \times g^{\cdot}(in_i) \qquad (1)$$

Where g' is the derivative of the activation function g. It is convenient to define a new term $\triangle$ which for output nodes is defined as $\triangle$ Err_i g'(in_i). So, the updating rule then becomes:

$$W_{Ji} < -W_{jI} + \alpha \times a_j \times \Delta_i \qquad (2)$$

To update the connection weights between the input units and the hidden units, we define a quantity analogous to the error term for output nodes. It is what we do the error back-propagation. The idea is that hidden node j is responsible for some of the error fraction Δ_i in every output node to which it connects. Thus, the Δ_i value is divided according to the strength of the connection between the hidden node and the output node, and propagated back to gain the Δ_i values for the hidden layer. The propagation rule for the value is the following:

$$\Delta_j = g^{\cdot}(in_j)\sum w_{ji}\Delta_i \qquad (3)$$

Now the weights updating rule between the inputs and the hidden layer is almost identical to the update rule for the output layer:

$$W_{Ki} < -W_{kj} + \alpha \times I_k \times \Delta_j \qquad (4)$$

IV. RESULT

A Neural network can be equipped with a Back Propagation algorithm that enables network to adjust the connection weights back, training it in response to representative examples [9]. The model in this study included input layer, hidden layer and output layer. The input data included 18 variables that are listed in table 2. The output layer consisted of only one output variable that is the customers' acceptance of a WeChat purchase.

TABLE II. INPUT VARIABLES IN THE NEURAL NETWORK

Item	Description	Item	Description
1	Gender	10	Security is better
2	often chatting on WeChat	11	Searching comments before buying
3	Rich experience of online shopping	12	Spending at least two hours on the Internet per day
4	Easy to search desired product on WeChat	13	Spending at least two hours on the Internet per day for personal needs
5	Browsing subscription news	14	spending at least two hours on the Internet per day for study
6	Price is the most important	15	Spending on the Internet per day for browsing
7	Online purchase for Saving time	16	Spending on the Internet per day for game
8	Providing more kinds of products/services	17	WeChat per day is the same time at home and at school
9	Privacy is better than other way	18	Meeting new friends by WeChat

Since there is currently no heuristic for determining the number of hidden nodes that should be included in any specific network, preliminary networks were tried to determine the appropriate size. Although networks with too few hidden nodes have difficulty in prediction, networks that are overly complex tend to memorize the training set causing the out-of–sample results to suffer [10]. In this study, preliminary model was tried that included eight, sixteen and thirty-two hidden nods. Networks with sixteen hidden nodes were found to be complex enough to map the data without adding additional error to the model.

To judge the users acceptance of WeChat purchase and determine the relative important inputs to model, the specific process of model training is as follow: Firstly, in the 528 student responses, four were incomplete and would be eliminated from the study; Secondly, all attributes are generalized, such as these attributes are generalized into low, middle, high or small, middle, large; And, we use BP algorithm for rule inferring from 524 samples. In the operation of BP, we use Matlab2012 for programming. To optimize the adjustable parameter, let step length of iteration is 0.015, 0.016, and 0.018. The accurate ratio of the neural network method is high when predicting the adoption of WeChat usage. Referring to what is presented in Table 3, in the 18 input variables; eight were identified by above algorithms. The gender, often chatting on WeChat, rich experience of online shopping, online purchase for saving time, and so on, are emphasized by neural network

method, and it suggests that the above factors have significant direct effects on the acceptance of app website.

TABLE III. INPUT VARIABLES INCLUDED IN THE FOUR NN MODELS

Item	1	2	3	4	5	6	7	8	9
Identified variables	*	*	*				*		
Item	10	11	12	13	14	15	16	17	18
Identified variables		*		*		*		*	

V. DISCUSSION

A. Implications

Based on the neural network algorithm, the research analyzed the data gained by the respondent survey with a number of n=528 university students. The purpose of the study was to estimate the purchase activity of the WeChat users and identify adopter characteristics. The accurate ratio of the BP method is high when predicting the customers' acceptance of WeChat purchase. And as was shown in Table 3, eight user characteristics emerged: gender, often chatting on WeChat, rich experience of online shopping, online purchase for saving time, and searching comments before buying, and so on.

As presented in the previous website design research, customers' characteristics on WeChat platform will have much effect on their behavior of app usage. The results of this research have important implications in the guide of WeChat app design. Our findings would provide suggestions of using the WeChat users' behavior to guide the design of app website. The results from our research have shown that some factors with regard to gender, often chatting on WeChat, rich experience of online shopping help people understand how to design app website well. In the app website setting, the advantage of the previous design thoughts will be greatly improved by taking into account the browsers experience, that are gender, often chatting on WeChat, rich experience of online shopping, and so on. In sum, this study has significant contributions to the theories of app design and the browser behavior analysis by providing empirical weight evidence on more factors.

B. Limitations and Future Research Direction

Some of the neural network might be used to discover clusters of customers in a marketing database. In our study, some limitations exist. Firstly, the sampling pool was restricted to mainly university students' circles, and most of respondents have highly educated degree and rich experience of online purchase. So, the study results might also be constrained within the youth. Thinking of more other mobile app users, such as white-collar workers, less educated, and less experienced on the online shopping, would drive us to develop more generalized model. Secondly, in this survey research, due to the private limitations, some important factors regarding individual preference differences, such as score, family income, consumption hobby, and so on, were deliberately left out. Finally, we don't think of the characteristics of product, such as low asset specificity and ease of description that would also differentiate the products correctly sold over the app. The input variables used in this study were restricted to demographics and finite in number. So, more variables should be included in future research to gain other value knowledge.

REFERENCES

[1] C.H. Lien, Y. Cao. "Examining WeChat users' motivations, trust, attitudes, and positive word-of-mouth: Evidence from China," Computers in Human Behavior, no.41, pp.104-111, 2014.

[2] Jieling Wu, C.L. Liu, D. Gardner. "A study of anonymous purchasing based on mobile payment system," Procedia Computer Science, no.83, pp.685-689, 2016.

[3] Ansari, S. Kohavi, R. & Mason, L. Integrating e-commerce and data mining: architecture and challenges. In Proc. 2001 IEEE Int. Conf. on Data Ming, pp. 27-34.

[4] Mohammad, R. Thabtah, F. & McCluskey, L. "Predicting phishing websites based on self-structuring neural network," Neural Computing & Applications, 2014, vol.25, no.2, pp. 443-458.

[5] Sudhanshu, S.P. Daniel, P. Ames. & Suranjan, P. "Application of vegetation indices for agricultural crop yield prediction using Neural network techniques," Remote Sensing, 2013, no.2, pp.673-696.

[6] Lee, D. Y. & Lehto, M. R. "User acceptance of YouTube for procedural learning: An extension of the technology acceptance model," Computers & Education, 2013. vol.61, pp. 193-208.

[7] Yuan, S. "Strategies for Chinese design schools to develop more effective websites," International Journal of Mechanical Engineering Education. 2013, vol.41, no.4,pp. 369-384.

[8] Wang, Q.Zh. W. Yi, Y. Qi, W. & Qingguo, M. "The effect of human image in B2C website design: an eye-tracking study," Enterprise Information Systems, 2014, vol.8, no.5, pp.582-605.

[9] Zhang, J. & Song, P. "Use of immune self-adaptation wavelet for data mining," the First International Conf. on Machine Learning and Cybernetics," November, China, p.156-160, 2002.

[10] Y.t. Jiang, X.Z. Zhou. "Combining scenarios survey and neural Network for solving the association of E-commerce usage," the Seventh Wuhan International Conference on E-Business, May, China, p.311-315, 2008.