4th International Conference on Web Research
April 25-26, 2018; Tehran, IRAN
ICWR2018
کنفرانس بین المللی وب پژوهی
چهارمین
۵ و ۶ اردیبهشت ۱۳۹۷؛ تهران، ایران

Inbound E-Marketing Using Neural Network Based Visual and Phonetic User Experience Analytics

Delaram Nedaei
Department of Computer Engineering
Khatam University
Tehran, Iran
d.nedaei@khatam.ac.ir

Pouria Khanzadi
Department of Computer Engineering
Khatam University
Tehran, Iran
p.khanzadi@khatam.ac.ir

Babak Majidi
Department of Computer Engineering
Khatam University
Tehran, Iran
b.majidi@khatam.ac.ir

Ali Movaghar
Department of Computer Engineering
Sharif University of Technology
Tehran, Iran
movaghar@sharif.edu

Abstract— **Inbound marketing is the process of attracting the probable customers to a business before they have any intention to become customers. An effective method for inbound marketing is creation of a positive psychological business environment to attract the customers. A significant portion of traditional business environment is moving online and the new business environment is the company website. One of the major elements in online inbound marketing is the website address and the website logo, which are the first factors of brand personality that the visitor to the company website encounters when looking up the website in a search engine. In this paper, a framework for inbound e-marketing using visual and phonetic user experience analytics is proposed. The popular websites are studied and the relationship between website page views and the English phonetic construction of the website address and its logo are analyzed. For demonstrating the relationship between the website logo and name and its appeal to the customers, the proposed model is trained by a neural network. The proposed model is capable to predict website page views based on the company logo and the website address. The experimental results show that the proposed framework is capable of recommending the strategy for inbound marketing for online business and services with high accuracy.**

Keywords— User experience, Neural network, Natural language processing, Image processing

I. INTRODUCTION

In the past few years, gradually the consumer behavior is changing and customers are using the internet-based services for finding various products and services. Therefore, with the increase in the percentage of e-commerce there is a significant competition between different digital marketing websites to make their products more appealing to the internet users. Inbound marketing is the process of attracting the possible customers to a website before they have any intention to become customers. An effective method for inbound marketing is creation of a positive psychological business environment to attract the customers. A significant portion of traditional business environment is moving online and the new business environment is the company website. One aspect of internet marketing strategy is improvement of user experience of the website. A website delivering forward-looking user experience wins over the online clients among the other e-commerce entrants [1]. User experience (UX) is defined as a set of facets of user's interaction with services and products provided by the company [2]. High quality user experience affects the user's decision-making process [3]. Ding et al. [4] show that product design and user experience can be of great importance for attracting the customers to a product or a service. Aizpurua et al. [5] found that there is a significant correlation between user experience and web accessibility and by providing accessibility the e-commerce websites can appeal to the general users.

Two major components of the user experience are the color psychology of the website and the phonetic construction of the website address. Color psychology is defined as the unconscious effect of color on behavior of a person [6]. The psychological impact of color creates a diverse range of emotions in a person and can make a person feel comfortable and warm or hostile and angry toward a product. Customers usually use the search engines in order to find their target products [7]. There are various choices in the search engine results. The first contact of the user with a website is the name of the website and the website logo. There is a significant research in the field of psychology which indicate that the phonetic construction of the brand names has significant effect of the consumer choice of that brand [8]. Product name and color are two factors that have the important role in product popularity among customers [9]. Furthermore, the color of various products is an important factor for attracting the consumers into purchasing and consuming that product [10, 11]. Cyr et al. [12] demonstrated that color has the most effect on attracting users to visit a website. Ettis [13] exposed the effect of online store color on online customer's behavior. The research also shows that the website color plays a role in user revisiting the website. A factor impacting multiple visits is visual aesthetics such as color hue and brightness [14].

Therefore, two subtle psychological factors influencing the user choice between various websites are the phonetic construction of the website address and the color psychology of the website logo. In this paper, first the color construction of the website logo for the top fifty most visited websites in shopping, recreation and general categories are investigated and the model of the color construction, which has significant impact on the consumer psychology, is presented. The shopping category includes Amazon.com, Netflix.com, Ebay.com, etc. The recreation websites contains Booking.com, 9gag.com, Tripadvisor.com, etc. The general websites which are used regularly by users are Google.com, Youtube.com, Facebook.com and so on. Then the text mining algorithms are used in order to explore the English phonetic construction of the same top visited websites. The model for the phonetic construction that has the most impact on the consumer psychology is presented. Finally, the model for the website logo's color construction and English phonetic structure for the website address is provided by using a neural network. The experimental results show that the proposed Web Traffic Recommender (Webtrec) framework can recommend a strategy for inbound marketing for online business and services with high accuracy.

The rest of this paper is organized as follows. The proposed framework including website logo and address analysis is detailed in Section II. The experimental design and the simulation scenarios are discussed in Section III. Finally, Section IV concludes the paper.

II. THE WEBTREC MODEL

Machine learning methods such as neural networks are able to solve many complex problems in pattern recognition and intelligent systems [15-18]. The Webtrec framework uses a Multilayer Perceptron (MLP) in order to model the connection between the user experience of a website and the website logo require for training the neural network are extracted from the website logo and phonetic construction of the website address as described in subsections A and B in section II. The neural network was trained to estimate daily website page views based on website address and logo color. In order to avoid overfitting, the neural network was trained by one website category and tested by the other two website categories. Webtrec framework is presented in Fig. 1.

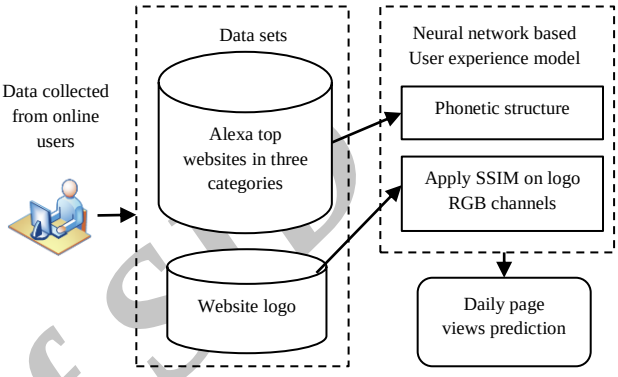

Fig. 1. The Webtrec framework

The top 50 websites were chosen based on Alexa ranking list [19]. The dataset comprised of website attributes such as place, domain address, daily time on site, daily page views per visitor, percentage of traffic from search, total sites linking in and descriptive website usage among females and males. Alexa provides the internet usage for each gender on expressive scale, which is termed: greatly under represented, under-represented, similar to internet average, over-represented and greatly over represented. We assigned 0, 0.25, 0.5, 0.75 and 1 to these terms respectively to convert them to the numeric scale. All data is anonymous to respect user's privacy. TABLE I. shows detailed summary of dataset collected from Alexa.com.

The features required for training the neural network are extracted from the website logo color analytics as described in subsection A and the phonetic construction of website name as described in subsection B of section II.

A. *Website logo analysis*

The website visual appearance is an important factor in website view statistics [20]. Furthermore, the website's logo is the first and most prominent visual attribute of a website and the visual attribute is the main feature that gains user's trust and loyalty [21]. Each top website in the dataset has a logo, which has two specific features: color and shape. As the shape of the logo depends on various branding specifications and usually can be changed, the color of the website logo has been chosen as one of the main features for Webtrec.

The similarity between color channels has been chosen to study the effect of the logo color on website visit statistics. This analysis method is performed using website logo analysis algorithm (WebLoAn). The flowchart of the WebLoAn algorithm is shown in Fig. 2.

TABLE I. THE STRUCTURE OF ALL THREE DATASETS COLLECTED FROM ALEXA.COM

Column	Values	
Place	1-50	
Site name	Website address	
Daily time on site	(mm:ss) per visitor	
Daily pageviews per visitor	Daily page views per website's visitor estimation	
% of Traffic from search	Search engines referrals percentage over month.	
Total sites linking in	The total number of websites that linked to this website	
gender	*Female*	0, 0.25, 0.5, 0.75 and 1
	Male	0, 0.25, 0.5, 0.75 and 1

One of the methods for measuring the quality of digital images is the Structural Similarity (SSIM) index [22]. In this paper, SSIM is used to measure the similarity between RGB color channels of website logos. The SSIM index of the two non-negative images *x* and *y* is defined as follows:

$$SSIM(x.y) = \left[l(x.y)^{\alpha} \cdot c(x.y)^{\beta} \cdot s(x.y)^{\gamma}\right] \quad (1)$$

Where the α, β and γ are positive parameters to modify the three components comparative position. The three comparison measurements are [22]:

$$l(x.y) = \frac{2\mu_x\mu_y+c_1}{\mu_x^2+\mu_y^2+c_1} \;.\; c(x.y) = \frac{2\sigma_x\sigma_y+c_2}{\sigma_x^2+\sigma_y^2+c_2} \;.\; s(x.y) = \frac{\sigma_{xy}+c_3}{\sigma_x\sigma_y+c_3} \quad (2)$$

In which μ and σ are the average and standard deviation of x and y. The constant c_1 is $c_1 = (K_1 L)^2$ where L is the pixel values range, and $K_1 \ll 1$. $c_2 = (K_2 L)^2$ and $c_3 = {}^{c_2}/_{2}$ where $K_2 \ll 1$ [22].

The result of the WebLoAn on one of the website logo is depicted in Fig. 3. The figure shows the RGB channel of "Khatam.ac.ir" logo and the result of SSIM between each color channel.

B. *Website address analysis*

All words have a visual concept in human's mind which affects human's decision and any small changes in the word has a huge effect in human's behavioral intentions [23]. In this paper, the effects of the phonetic construction of the websites domain names are chosen as the second feature for training the neural network. Each domain address in the dataset is comprised of three parts:

$$WDA = WWW + dot + SN + dot + HN \quad (3)$$

In which *WDA* is web domain address, dot is ".", *SN* is the site name and *HN* is the host name. The phonetic construction of *SN* is used for construction of the second feature used for training the neural network. The *SN* is first deconstructed into vowels and non-vowel English alphabets:

$$SN = NV + NNV \quad (4)$$

In which *NV* is the number of the vowels and *NNV* is the number of non-vowel letters in *SN:*

$$NV = \sum_{i=1}^{5} f(v_i) \;\; .v = \{a.e.i.o.u\} \quad (5)$$

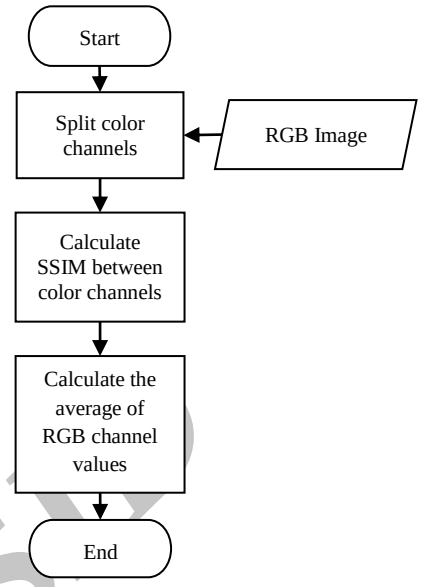

Fig. 2. WebLoAn algorithm Flowchart

By considering the ratio between *NV* and length of the *SN*, usage and importance of the vowels in the website domain name can be calculated. We call this measure Number of the Vowels Ratio (NVR):

$$NVR = \frac{NV}{length(SN)} \quad (6)$$

NVR is calculated for each website in the dataset. By calculating the ratio between *NNV* and length of *SN*, Number of the Non-Vowels Ratio (*NNVR*):

$$NNVR = \frac{NNV}{length(SN)} \quad (7)$$

NVR and *NNVR* are features that represent the frequency of the letters in the website domain name.

The second feature used for investigating the phonetic construction of the website domain name is the English alphabet placement in the domain name. In this study, English language is considered for its widespread use around the world and the Internet. By considering the place of vowels, we can split English alphabet into five groups. In TABLE II. , we have assigned a number between 1 and 26 to the English letters as External place (Place-E). Consequently, we split the English letters by vowels. In each part between vowels, we assign a number between 1 and 5 based on the length of the section as yellow and green parts and name them the Internal Place (Place-I) to find consonants places in each word of the website domain name.

The proposed website address analysis method is called ALphabet Properties Analysis (ALPA). ALPA examines the effect of website address. The Fig. 4 describes the ALPA architecture. The output is page view rates based on web address. The results of this calculation are demonstrated in experimental results section.

The Webtrec framework uses an MLP architecture for regression based on the visual and phonetic structure of the website. The features require for training the neural network

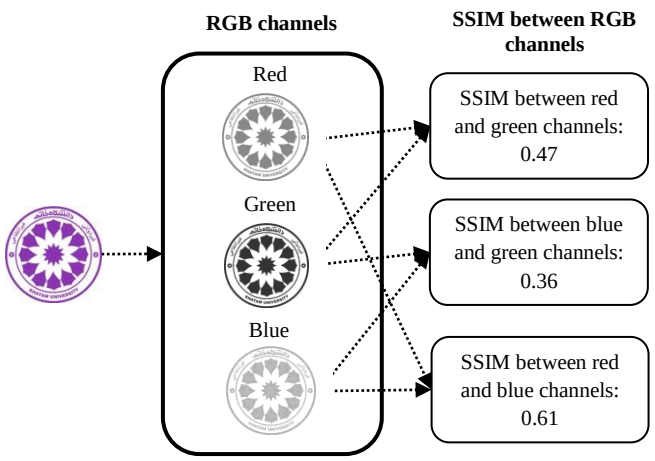

Fig. 3. An Example of WebLoAn calculation on RGB channels on the logo of Khatam University.

TABLE II. ENGLISH ALPHABET AND EXTERNAL AND INTERNAL PLACE ASSIGNMENT

Letter	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Place-E	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Place-I		1	2	3		1	2	3		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
Length		3				3				5						5						5				
Group		1				2				3						4						5				

are extracted from the website logo and phonetic construction of the website address as described in Section II. The neural network was trained to estimate daily website page views based on website address and logo color.

III. EXPERIMENTAL RESULTS

An MLP network with three hidden layers was designed using nnet method [24] in Caret package [25] built in R [26]. The dataset mentioned in Section II is used for experimental results. The dataset for each website includes the place, website name, daily time on site (*DTS*), daily page view per visitor (*DPV*), traffic from search (*TFS*), total site linking in (*TSL*), gender female, gender male, logo source and logo image for first fifty websites. This study aims to consider user experience patterns of most visited website's phonetic construction and its logo color. The prediction made by the trained neural network is evaluated by linear and non-linear regression. The model accuracy is calculated by Mean Absolute Error (MAE) measure ($MAE = \frac{\sum_{i=1}^{n}|e_i|}{n}$) [27].The neural network inputs for predicting daily page visits based on website address are *DTS* and *VRS*, while *DPV* is the output. The output layer in the neural network has one node. The *VRS* parameter is an attribute, which is extracted from data. The pattern analysis of logo color uses *VRS* and *SSIM* as inputs and the output is *DPV*.

In the first step of the experimental results the phonetic construction of the website domain name is calculated using *NVR* and *NNVR*. Due to (3), each website can have specific *SN* and *HN*. Fig. 5 shows the diagram of *WDA* parameters of websites in general website category.

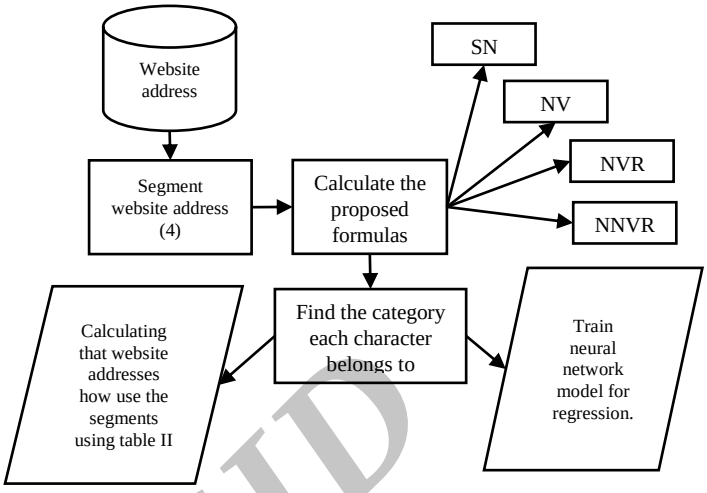

Fig. 4. ALPA architecture

For a group of websites *HN* has two parts e.g. ".co.uk", ".com.br" and etc., therefore we consider two parts for *HN*:

$$HN = HN_1 + HN_2 \quad (8)$$

The correlation between VRS and DPV Fig. 6, is calculated by applying Pearson, Kendall and Spearman. These parameters belong to websites in general category. The correlation results are shown in TABLE III.

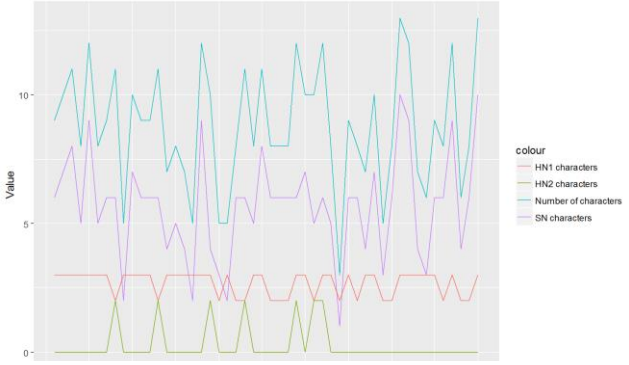

Fig. 5. Number of characters based on WDA definition

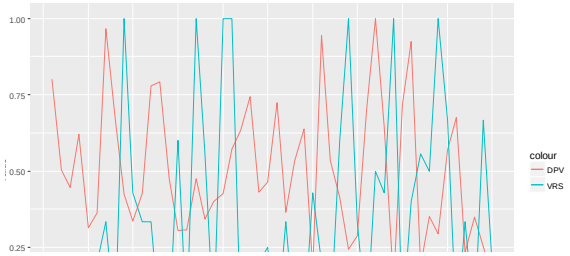

Fig. 6. *VRS* and *DPV* diagram.

TABLE III. CORRELATION BETWEEN *VRS* AND DATASET PARAMETERS.

Method	(*DPV*,*VRS*)	(*TFS*,*VRS*)	(*TSL*,*VRS*)	(*DTS*,*VRS*)
Kendall	-0.28	0.24	-0.18	-0.14
Pearson	-0.34	0.07	-0.28	-0.19
Spearman	-0.40	0.36	-0.26	-0.22

Variance of *SN* in Fig. 5 is 4.18. Therefore, the number of characters is limited to specific bandwidth and rapid changes are not observable. ALPA provides two ratios: *NVR* and *NNVR*. We define Vowels Ratio Subtraction (VRS) as follows:

$$VRS = |NVR - NNVR| \quad (9)$$

By using *VRS*, we can examine the similarity between *VRS* changes and the website usage properties in the dataset: the normalized of *DPV*, *TFS*, *TSL* and *DTS*. In Fig. 7.

A. *Regression results of five parameters*

All the five parameters in shopping websites are examined using linear and non-linear regression, which as a sample the changes of *VRS* and *DPV* is demonstrated in Fig. 8. The results reveal the ALPA model predicted the new data with high accuracy. To evaluate the predictor, Mean Absolute Error has been conducted. The result of Mean absolute error between predicted and actual values are shown in 0TABLE IV.

The five parameters of recreation category websites are studied using linear and non-linear regression and the results are shown in Fig. 9. The outcomes show that the ALPA model predicted the new data with high accuracy. MAE has been applied to evaluate the predictor and depicted in TABLE V. The results show that non-linear regression has more accurate prediction than linear regression. As depicted in TABLE VI. , the ALPA shows that most of the alphabets used in top websites are placed in the third group of external categories.

B. *Regression results of five parameters and SSIM index*

The research related to color effects on human behavior highlighted that color influences the human decision-making and user experience [28]. Many standards are proposed for image quality assessment [29]. In this paper, we investigated the color of the most visited website's logo using the structural similarity (SSIM) index. A sample of the results is depicted in Fig. 10 for shopping websites, where the image is linear regression diagram of *DPV* parameter by SSIM. The predicted model has been evaluated by MAE, which is summarized in order in TABLE VII. and TABLE VIII. for shopping websites and recreation websites respectively.

The previous related works are summarized in TABLE IX. This study considered website logo color and its address to evaluate user experience in the most visited websites. Although many researchers studied the impact of color on human behavior, but they did not model the color of websites with high visit rates and its effect on user experience. Several studies have investigated the power of vowels and consonant sounds on human's mental attitude that affects the decision-making process. The Webtrec model combines color effects and phonetic structure in commercial websites and investigate

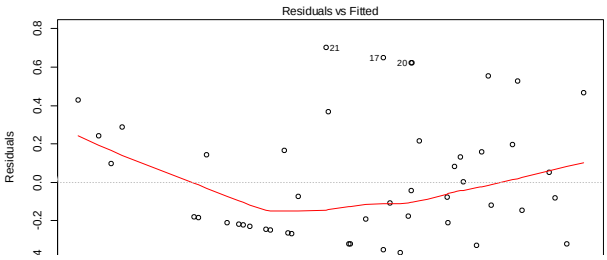

Fig. 7. VRS and DPV linear regression diagram.

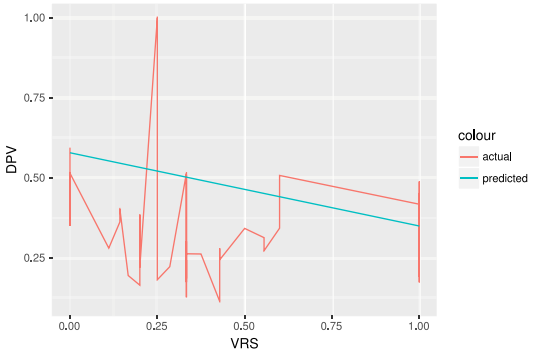

Fig. 8. Regression of top fifty shopping websites.

TABLE IV. CORRELATION BETWEEN DATASET PARAMETERS.

linear DPV/VRS	Linear DTS/VSR	Linear TFS/VSR	Linear TSL/VSR	non-linear DPV/DTS/VSR
0.19	0.13	0.39	0.24	0.19

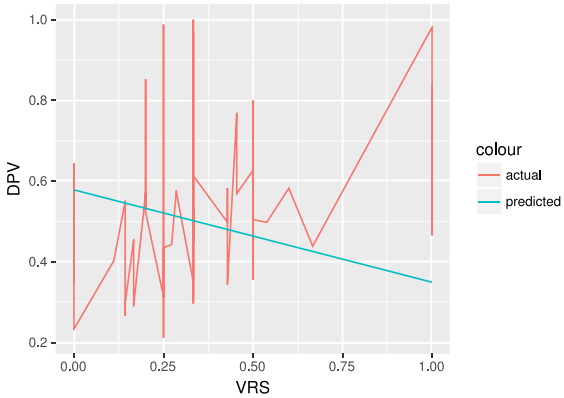

Fig. 9. Regression of top fifty recreation websites.

TABLE V. MEAN ABSOLUTE ERROR BETWEEN PREDICTED AND ACTUAL VALUES.

linear DPV/VRS	Linear DTS/VSR	Linear TFS/VSR	Linear TSL/VSR	non-linear DPV/DTS/VSR
0.17	0.14	0.24	0.25	0.11

TABLE VI. MEAN OF NUMBER OF ALPHABETS APPEARED IN EACH GROUP.

V1	V2	V3	V4	V5
0.42	0.72	0.96	0.82	0.34

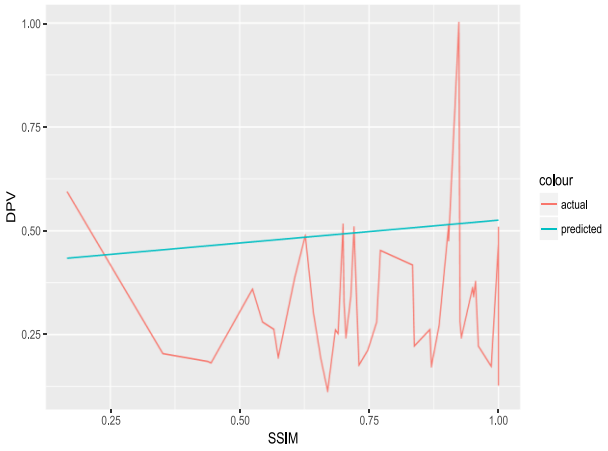

Fig. 10. Regression of top fifty shopping websites.

TABLE VII. MEAN ABSOLUTE ERROR BETWEEN PREDICTED AND ACTUAL VALUES.

linear DPV/VRS	Linear DTS/VSR	Linear TFS/VSR	Linear TSL/VSR	non-linear DPV/DTS/VSR
0.20	0.36	0.39	0.26	0.19

TABLE VIII. MEAN ABSOLUTE ERROR BETWEEN PREDICTED AND ACTUAL VALUES.

linear DPV/VRS	Linear DTS/VSR	Linear TFS/VSR	Linear TSL/VSR	non-linear DPV/DTS/VSR
0.15	0.36	0.24	0.24	0.16

TABLE IX. THE RELATED WORKS.

References	Algorithm description	Performance Evaluation
The proposed model	Website logo color and phonetic structure of website address and how it impacts on UX are analyzed.	Both website logo color and phonetic structure of website address impacts on UX are investigated.
Ettis [13]	Investigated impact of yellow hue vs. blue hue as an SOR model	The results revealed that blue hue encourages more flow experience than yellow and concentration has great effects on the website visit rates. Only color analysis is performed.
Seckler et al. [14]	Examined website aesthetic features like blue hue, brightness, etc.	The study shows that blue hue websites with high symmetry, low complexity and medium brightness received the highest ratings in aesthetics perception. Only color analysis is performed.
Maglio et al. [23]	Discovered the impact of vowel sounds on human's purpose intention	The study found a relationship between vowel sound and visual in addition to conceptual precision. People show great care to front vowels than back vowels. Only phonetic analysis is performed.

how they impact the user experience

IV. CONCLUSION

This study investigated the website user experience using the phonetic construction of the website address and visual structure of the website logo. It is discovered that there is a correlation between number of user's visits on the website and two features of website (website address and logo color) which are the aesthetic factors that make first impression on users. The proposed Webtrec model can predict daily page views of new website according to the website address and its logo color with high accuracy. by means of regression model trained by neural network. This examination was conducted on online marketing websites. Therefore, future study is recommended on correlation between online advertising strategies and user experience. An appropriate advertising with impressive user experience wins over more online shoppers and leads the company to conspicuous success.

REFERENCES

[1] C.-L. Hsu, Y.-C. Chen, T.-N. Yang, and W.-K. Lin, "Do website features matter in an online gamification context? Focusing on the mediating roles of user experience and attitude," *Telematics and Informatics*, vol. 34, pp. 196-205, 7// 2017.

[2] D. Norman and J. Nielsen. (2017, 05-24). *The definition of user experience*. Available: https://www.nngroup.com/articles/definition-user-experience/

[3] J. Jankowski, P. Kazienko, J. Wątróbski, A. Lewandowska, P. Ziemba, and M. Zioło, "Fuzzy multi-objective modeling of effectiveness and user experience in online advertising," *Expert Systems with Applications*, vol. 65, pp. 315-331, 12/15/ 2016.

[4] Y. Ding, F. Guo, X. Zhang, Q. Qu, and W. Liu, "Using event related potentials to identify a user's behavioural intention aroused by product form design," *Applied Ergonomics*, vol. 55, pp. 117-123, 7// 2016.

[5] A. Aizpurua, S. Harper, and M. Vigo, "Exploring the relationship between web accessibility and user experience," *International Journal of Human-Computer Studies*, vol. 91, pp. 13-23, 7// 2016.

[6] I. Puntenney, "Color Psychology and Color Therapy," *American Journal of Ophthalmology*, vol. 33, p. 1619, 1950/10/01/ 1950.

[7] G. T. Lumpkin and G. G. Dess, "E-Business Strategies and Internet Business Models:: How the Internet Adds Value," *Organizational Dynamics*, vol. 33, pp. 161-173, 2004.

[8] L. Shrum and T. M. Lowrey, "Sounds convey meaning: The implications of phonetic symbolism for brand name construction," *Psycholinguistic phenomena in marketing communications*, pp. 39-58, 2007.

[9] E. Seimiene and E. Kamarauskaite, "Effect of Brand Elements on Brand Personality Perception," *Procedia - Social and Behavioral Sciences*, vol. 156, pp. 429-434, 11/26/ 2014.

[10] N. A. Jalil, R. M. Yunus, and N. S. Said, "Environmental Colour Impact upon Human Behaviour: A Review," *Procedia - Social and Behavioral Sciences*, vol. 35, pp. 54-62, // 2012.

[11] M. Vasiljevic, R. Pechey, and T. M. Marteau, "Making food labels social: The impact of colour of nutritional labels and injunctive norms on perceptions and choice of snack foods," *Appetite*, vol. 91, pp. 56-63, 8/1/ 2015.

[12] D. Cyr, M. Head, and H. Larios, "Colour appeal in website design within and across cultures: A multi-method evaluation," *International Journal of Human-Computer Studies*, vol. 68, pp. 1-21, 1// 2010.

[13] S. Aboubaker Ettis, "Examining the relationships between online store atmospheric color, flow experience and consumer behavior," *Journal of Retailing and Consumer Services*, vol. 37, pp. 43-55, 7// 2017.

[14] M. Seckler, K. Opwis, and A. N. Tuch, "Linking objective design factors with subjective aesthetics: An experimental study on how structure and color of websites affect the facets of users' visual aesthetic perception," *Computers in Human Behavior*, vol. 49, pp. 375-389, 8// 2015.

[15] W. Liu, Z. Wang, X. Liu, N. Zeng, Y. Liu, and F. E. Alsaadi, "A survey of deep neural network architectures and their applications," *Neurocomputing*, vol. 234, pp. 11-26, 2017/04/19/ 2017.

[16] M. Haji Abbasi, B. Majidi, and M. T. Manzuri, "Glimpse-Gaze Deep Vision for Modular Rapidly Deployable Decision Support Agent in Smart Jungle," presented at the 6th Iranian Joint Congress on Fuzzy and Intelligent Systems, Kerman, Iran, 2018.

[17] M. Haji Abbasi, B. Majidi, and M. T. Manzuri, "Deep Cross Altitude Visual Interpretation for Service Robotic Agents in Smart City," presented at the 6th Iranian Joint Congress on Fuzzy and Intelligent Systems, 2018.

[18] B. Majidi, J. C. Patra, and J. Zheng, "Modular interpretation of low altitude aerial images of non-urban environment," *Digital Signal Processing*, vol. 26, pp. 127-141, 2014.

[19] A. Internet. (2017, April-May). *Alexa top web sites by category*. Available: http://www.alexa.com/topsites

[20] K. Al-Qeisi, C. Dennis, E. Alamanos, and C. Jayawardhena, "Website design quality and usage behavior: Unified Theory of Acceptance and Use of Technology," *Journal of Business Research*, vol. 67, pp. 2282-2290, 11// 2014.

[21] M. Seckler, S. Heinz, S. Forde, A. N. Tuch, and K. Opwis, "Trust and distrust on the web: User experiences and website characteristics," *Computers in Human Behavior*, vol. 45, pp. 39-50, 4// 2015.

[22] W. Zhou, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli, "Image quality assessment: from error visibility to structural similarity," *IEEE Transactions on Image Processing*, vol. 13, pp. 600-612, 2004.

[23] S. J. Maglio, C. D. Rabaglia, M. A. Feder, M. Krehm, and Y. Trope, "Vowel sounds in words affect mental construal and shift preferences for targets," *Journal of Experimental Psychology: General*, vol. 143, p. 1082, 2014.

[24] W. V. Brian Ripley, "nnet," 7.3-12 ed, 2016, pp. Software for feed-forward neural networks with a single hidden layer, and for multinomial log-linear models.

[25] K. Max and W. Jed, "Package 'caret'," 6.0-76 ed, 2017, p. Misc functions for training and plotting classification and regression models.

[26] R. C. T. (2017), "R: A language and environment for statistical computing.," ed: R Foundation for Statistical Computing, 2017.

[27] C. J. Willmott and K. Matsuura, "Advantages of the mean absolute error (MAE) over the root mean square error (RMSE) in assessing average model performance," *Climate research*, vol. 30, pp. 79-82, 2005.

[28] F. Zhou, B. Lei, Y. Liu, and R. J. Jiao, "Affective parameter shaping in user experience prospect evaluation based on hierarchical Bayesian estimation," *Expert Systems with Applications*, vol. 78, pp. 1-15, 7/15/ 2017.

[29] P. Khanzadi, B. Majidi, and E. Akhtarkavan, "A Novel Metric for Digital Image Quality Assessment using Entropy-Based Image Complexity," presented at the 4th International Conference on Knowledge-Based Engineering and Innovation, Tehran, Iran., 2017.