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Assessing Classical and Expressive Aesthetics of Web Pages using Machine Learning

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ABSTRACT

Aesthetics plays a key role in web design. However, most websites are developed based on designers' "inspirations" or "educated guesses" (Liu, 2003). While perceptions of aesthetics are intuitive abilities of humankind, the underlying principles for assessing aesthetics are not well understood. In this research, we propose using machine learning techniques to explore and more fully understand the patterns and underlying principles of aesthetics. We propose using machine learning techniques to develop predictive models for two aesthetic dimensions – classical aesthetics and expressive aesthetics – as well as for overall aesthetics of web pages in order to evaluate the aesthetic quality of web pages.

Keywords

Aesthetics, web aesthetics, machine learning, classical aesthetics, expressive aesthetics, overall aesthetics.

INTRODUCTION

Given the importance of aesthetics, more attention in research should be devoted to assessments of web aesthetics. Aesthetics has been shown to have a dominant influence in e-commerce such as in influencing buyers' purchase decisions (Postrel, 2002). Aesthetics also affects users' evaluations (Tractinsky et al., 2000) and preferences (Schenkman and Jonsson, 2000; van der Heijden, 2003). A good web page design can bring many benefits, such as increasing registration rates, subscription rates, volume of downloads, and conversion rates. Research has shown that web design is a major determinant of perceived credibility and trustworthiness. Hence, web aesthetics, which is an important aspect of web design, warrants attention in research (Fogg et al., 2002; McKnight et al., 2002).

In the human-computer interaction (HCI) area, attention given to aesthetics is minimal or far from adequate (Tractinsky, 2004). Although designers are aware of the importance of aesthetics, design decisions are mainly based on "inspiration" and "educated guesses" (Liu, 2003). Furthermore, there is a lack of quantitative metrics for assessing aesthetics. With recent advances in machine learning and the increasing availability of data, machine learning techniques have become more powerful and relevant for understanding complex phenomena and can potentially help us to understand and assess aesthetics in HCI.

Lavie and Tractinsky (2004) assessed visual aesthetics of websites by breaking it down into two high-level dimensions – classical and expressive aesthetics. Classical aesthetics refers to clean, functional and orderly style of design, whereas expressive aesthetics refers to design with novelty and richness. Studies show that both dimensions of aesthetics can affect users' task performance and preferences (Cawthon and Moere, 2007; Tractinsky et al. 2000).

The main objective of this research is to develop predictive models to assess classical and expressive aesthetics as well as overall aesthetics of web pages. Overall aesthetics refers to the aesthetic quality of a web page design.

BACKGROUND & LITERATURE REVIEW

Aesthetics studies focus on the process of humans recognizing, judging, and applying beauty. As mentioned earlier, aesthetics has two high-level dimensions—classical and expressive aesthetics. Both dimensions of aesthetics create value by stimulating viewers' emotions of pleasure and satisfaction. However, it is hard to identify which of them is more important in an attractiveness evaluation.

According to Norman (1998) and Carr (2003), advances in the functionality of information technology have exceeded most of the requirements and needs of individuals and commercial organizations. With rapid development of information technology and the market, functionality is just the "ticket" for entering the competition, whereas the aesthetic aspect is the key to success (Liu, 2003). Nowadays, companies are gaining a competitive advantage by developing web pages which are of high aesthetic quality to influence the attitudes and perceptions of customers. However, research on this increasingly important topic is still lacking in the MIS and HCI research field (Tractinsky, 2004).

Aesthetics is highly relative to individual preferences (Tractinsky, 2004). Due to individual and cultural differences, aesthetics could be perceived differently by people. Some people prefer concise (classical) design while others prefer creative and original (expressive) design. If people develop preferences for more attractive designs, assessments of objective feature information may shift in the direction of more attractive products (JoAndrea et al., 2010).

THEORETICAL FOUNDATION

Although aesthetics is a very subjective concept, quantitative aesthetic measures do exist to quantify various aesthetic features of screen layouts. We summarize six aesthetic measures (Ngo, 2001; Ngo et al., 2003): Balance (BM), Equilibrium (EM), Symmetry (SYM), Sequence (SQM), Order and Complexity (OM), and Regularity (RM). The six measures are adapted from Ngo`s theory of modeling interface aesthetics. Zain et al. (2008) developed an aesthetic measure application (AMA) for aesthetics of web pages by drawing on the six measures from Ngo et al. (2003). Maity et al. (2017) found nine measures that are statistically significant for assessing webpage aesthetics. These nine measures are: balance, cohesion, equilibrium, homogeneity, proportion, regularity, sequence, symmetry, and unity. Since users are the subjects who form aesthetic perceptions, it is crucial to study how demographic differences between users can lead to different aesthetic perceptions. Demographic information includes culture, language, gender, age, etc. The assessment of color is excluded and outside the scope of this research.

Machine learning techniques can be used to analyze the underlying patterns of how humans perceive the aesthetic quality of web pages. Machine learning automatically analyzes and summarizes systematic patterns from the data provided, and it uses these patterns to make predictions. Evaluating aesthetics is a highly subjective task; however, we believe there are certain rules, guidelines, and commonalities in human nature to assess aesthetics.

METHODOLOGY

The main objective of this research is to develop predictive models to assess web page aesthetics in terms of classical aesthetics, expressive aesthetics, and overall aesthetics. By using crowdsourcing to collect data and supervised learning to analyze the data collected, we will identify and analyze patterns of web page aesthetics. We are also interested in predicting the aesthetic scores of web pages.

For data collection, we will use Amazon Mechanical Turk (Mturk) to solicit participants to rate three measures of aesthetics (i.e., classical aesthetics, expressive aesthetics, and overall aesthetics) of a variety and large number of web pages. In other words, a survey method will be used to collect data on web page aesthetics that will be used by the machine learning model to learn and analyze web page aesthetics.

For data analysis, key feature information of web pages, along with the aesthetic assessments of these web pages, will be fed into machine learning algorithms. We will ensure that there is a wide spectrum of aesthetic quality measurement in our data set to facilitate and optimize the training process. Due to the fact that classical aesthetics and expressive aesthetics are higher-level concepts, specific features may be quite different across the web pages. Thus, machine learning is used to solve this complex and potentially computationally intensive processing problem.

Neural network and Support Vector Machine (SVM) are two machine learning techniques that we will use for training the data set (Ravindran and Nah, 2017). Neural networks, or deep learning, can provide non-linear analysis of data. The web page features that we have extracted formed the input layer. The aesthetic measures are the output layer. Through back propagation, the weighting factors of features are learned in the hidden layers. We will train the neural networks to predict the values of two aesthetic dimensions—classical and expressive aesthetics. SVM is a supervised learning model with relevant algorithms that can carry out both linear and non-linear classifications. In this research, the SVM is utilized to separate web pages into two aesthetic dimensions: classical and expressive aesthetics.

We would also like to assess the accuracy of our models. Thus, we would separate our dataset into two parts: training and testing. We will assess the predictions of the aesthetic dimensions (classical and expressive) and the overall aesthetics.

EXPECTED CONTRIBUTIONS

Predictive and quantitative models for evaluating web page aesthetics will be developed in this research. The research is expected to help us gain a better understanding of the patterns and underlying principles of aesthetics. In addition, we use machine learning techniques to quantify and model the intuitive ability of humans to assess aesthetics, which has been a hotspot in recent research. We hope to develop models that not only can assess aesthetics of web pages, but can also provide recommendations on the design of aesthetic web pages.

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