Automatic Adaptation of User Interfaces to Cultural Preferences

Automatische Anpassung von Benutzeroberflächen an kulturelle Vorlieben

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Summary   Our culture strongly affects which Web sites we perceive as beautiful and usable, and we are less likely to engage with those that we don't. With today's Internet users coming from a variety of cultural backgrounds, it is not realistic to provide one interface design that is perceived as appealing by everyone. We therefore developed an approach to culturally adaptivity, which enables an automatic composition of personalized interfaces by taking into account a user's current and former countries of residences. To exemplify the approach, we created a Web application that offers more than 115 000 different versions of its interface in order to adequately adapt to various combinations of different national cultures. Our evaluations of the Web application with participants from Rwanda, Switzerland, and Thailand, as well as with multicultural users from all over the world, demonstrated that the approach is able to anticipate 61% of user preferences on average (compared to 33% that the system achieved when randomly generating its interfaces). Moreover, the results of an experiment with 41 multicultural participants showed that they were significantly faster with their personalized version compared to a standard US interface, they needed fewer clicks to complete tasks, and made fewer errors. These results were also supported by participants' subjective impressions of appeal and work efficiency, showing that cultural adaptivity is a feasible way to increase the user experience for a multicultural audience. ▶▶▶ **Zusammenfassung** Unser kulturelle Hintergrund beeinflusst welche Webseiten wir als schön und leicht benutzbar empfinden und mit welchen wir uns näher beschäftigen. Mit der grossen Vielzahl verschiedener Benutzerkulturen im Internet ist es daher nicht mehr realistisch, Webseiten mit einem Standarddesign anzubieten und damit jedem Geschmack gerecht werden zu wollen. Wir haben daher eine Methode erarbeitet, die es erlaubt, automatisch auf den persönlichen kulturellen Hintergrund einer Person abgestimmte Benutzeroberflächen zusammenzustellen. Um die Methode zu veranschaulichen haben wir eine Webapplikation entwickelt, die sich mit mehr als 115.000 verschiedenen Kompositionsmöglichkeiten ihrer Oberfläche an die Vorlieben einer grossen Anzahl verschiedener Landeskulturen, sowie an multikulturelle Benutzer, die in mehreren Ländern gelebt haben, anpassen kann. Evaluationen dieser Webapplikation in Ruanda, der Schweiz, Thailand, sowie mit multikulturellen Benutzern aus den verschiedensten Teilen der Welt, zeigten, dass unsere Methode durchschnittlich 61% der Benutzerpräferenzen richtig vorhersagen kann (verglichen mit 33%, die durch zufällig generierte Oberflächen erreicht werden konnten). In einem weiteren Experiment mit 41 multikulturellen Teilnehmern konnten wir zeigen, dass diese effizienter mit ihrer personalisierten Version arbeiten konnten, als mit der US-Version derselben Webapplikation. Die Teilnehmer brauchten zudem weniger Klicks, um die ihnen gestellten Aufgaben zu erledigen und machten weniger Fehler. Die Resultate wurden durch die subjektiven Eindrücke der Teilnehmer bestätigt, die das Aussehen und die Benutzbarkeit der personalisierten Version im Durchschnitt als besser bewerteten. Kulturelle Adaptivität hat sich daher als eine praktikable Methode herausgestellt, um das Benutzererlebnis für eine multikulturelle Zielgruppe zu verbessern.

1 Introduction

Surfing the Web has become as much part of our lives as walking down the street in the real world. And just as we expect our local shopping street to have a certain look with more or less advertisements lining the way, we apply the same expectations and preferences to the virtual world. The bustling, colorful streets of Seoul, for example, are mirrored in South Korea's most popular search engine Naver.com shown in Fig. 1a. The site's high complexity, its blinking animations, and the variety of services that it offers are usually perceived as an unsettling information overload to Westerners. In fact, Google, with its minimalist design and focus on search (Fig. 1b), holds a market share of more than 90% in most Western countries. In South Korea, however, Google's share of searches in 2011 remains below 10%.

The example of Google and Naver suggests that users across the world have divergent preferences towards the design and functionality of Web sites. I observed similarly striking differences when developing an e-learning portal in Rwanda several years ago. While my initial design was very consistent with what I thought was a universal design principle to "keep it simple", I very quickly had to learn that Rwandans preferred a more playful and more colorful look, a linear navigation without many learning choices, and a wizard similar to Microsoft's office clip that would lead them through the learning process. It was only several months later that I realized that this is

a) Naver

b) Google

Figure 1 Search engine competitors Naver and Google.

very consistent with the Rwandan culture. A primarily teacher-centered education, for example, can determine how comfortable users are with the non-linear navigation scheme of the World Wide Web. And a wizard does not only serve as a buddy for the community-loving Rwandans, but it also provides comforting guidance when too many choices might otherwise seem overwhelming.

Thus, a key to understanding people's preferences for certain user interface designs is to understand their national psyche, including cultural influences such as political orientation, the way society is organized, or education [11]. Indeed, user interfaces that have been adapted to the needs and preferences of a certain target culture have been found to be more usable, more appealing, and more trustworthy [3; 4; 6]. Yet to date, only few Web pages offer a different look & feel for users from other countries than that of the developers. In fact, the so-called localization of user interfaces is usually restricted to an adaptation of the language and date/time formats, but does not involve a whole re-arrangement of the user interface. As a result, many Web sites fail to attract an international audience: In an online world where the next site is just a click away, users are often reluctant to engage with Web pages that they find unappealing, untrustworthy, or unintuitive.

To contrast today's one-size-fits-all designs, we developed an approach to user interfaces that automatically adapt their look & feel to a user's cultural preferences. Such culturally adaptive user interfaces require as input the user's current and former countries of residence as well as the duration that the user has lived in each of these countries. Based on this, the system calculates a weighted average of cultural influences on the user's "extended national culture", looks up the corresponding adaptation rules, and presents a modified interface. We hypothesized that culturally adaptive user interfaces improve the overall usability, and specifically, increases work efficiency and user satisfaction.

2 Mapping Culture to Interface Preferences

Anticipating the optimal interface for a person of a specific cultural background is probably impossible given the intangible nature of culture. The concept remains a fuzzy collection of possible influences such as a person's nationality, the parents' nationalities, education level, religion, or political orientation – all of which affects preferences in different ways [11]. There are arguably not two people with the same culture, yet cultural groups often share at least similar world views and values. This has been also previously observed at a country level: People belonging to the same "national culture" have mostly been exposed to very similar cultural influences throughout their life, and show comparable behavioral patterns, principles, and partialities. In the field of human-computer interaction, users of the same national culture have been also found to share similar design preferences.

To compare cultures and their particularities researchers have often referred to cultural classifications, one of the most widely used ones being by cultural anthropologist Hofstede [8]. Studying differences in organizational culture between a large number of countries, he derived the five dimensions Power Distance, Masculinity, Uncertainty Avoidance, Individualism, and Long Term Orientation (please refer to [7] for an explanation of the dimensions). Each country receives a score on each of these dimensions, which indicate whether a country is highly individualist, such as the US, or has a high power distance, such as many Asian countries, where hierarchies are often deeply-rooted in society.

Much of what we know about the varying design preferences in different cultures is based on these dimensions. Previous research, for example, has demonstrated that users from countries with a high uncertainty avoidance (e.g., many Latin American countries) prefer a linear navigation paired with an increased guidance [2]. Highly masculine cultures (e.g., Slovakia, Austria) tend to like highly saturated colors [5], and low individualists often choose a much more colorful design than the tone-in-tone style found in many Websites of high individualist countries [1].

3   Cultural Adaptivity

In our approach, we made use of Hofstede's classification of national cultures by linking each of his dimensions to certain user interface preferences based on studies in the related literature. The dimension long term orientation, for example, has been found to relate to a preference for a certain degree of complexity at the interface level. The score that a country received in Hofstede's study then defines whether the interface should be adapted to offer a low, medium, or high complexity. The whole set of adaptation rules (listed in [10]) therefore predicts the design preferences of people of a certain national culture. Additionally, our approach enables user interfaces to adapt to a user's extended national culture by factoring in his or her different countries of residence as well as the duration that the user has lived in each of these countries.

To exemplify this approach, we have built a culturally adaptive to-do list Web application called MOCCA [9; 10], which can change its modular user interface to more than a 115 000 different looks depending on a user's extended national culture. MOCCA takes as input a user's previous countries of residence as well as the durations, and presents a personalized look from the beginning on. In addition, users have the ability to later manually modify the interface. A built-in collaborative filtering algorithm, similar to Amazon's "Users who have bought this book also bought…", observes these modifications, and matches them to a specific cultural background. If several users of a similar culture show similar preferences, MOCCA learns new, or modifies its existing adaptation rules.

4   Evaluation of a Culturally Adaptive Website

Our evaluations of MOCCA were targeted to answer two main research questions:

1. Does MOCCA present interfaces that users would have chosen themselves?, and
2. Is such a culturally adaptive system superior to a non-adapted Website in terms of work efficiency and user satisfaction?

To answer the first question, we conducted studies with 105 participants in Rwanda, Switzerland, and Thailand, and with multicultural participants who had lived in at least two different countries. Participants were lead through a number of questions asking them to choose from paper-based mock-ups of MOCCA's user interface. Their self-designed interface was then compared to the version that MOCCA presented after we entered a participant's current and former countries of residence.

This first experiment demonstrated that MOCCA is able to anticipate 61% of participants' preferences on average across all adaptable user interface aspects. By comparison, only 33% accuracy could be achieved if MOCCA randomly composed its interfaces. We also found that our participants in Rwanda, Switzerland, and Thailand designed very similar user interfaces for themselves within a country, but that the interfaces looked very different between the three countries (see Fig. 2). This suggests that preferences are at least partially similar within a national culture, but it also suggests that learning from users' preferences based on cultural similarity is very well feasible.
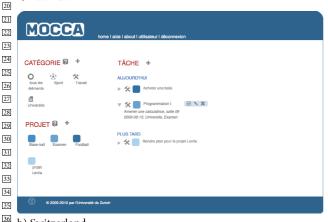
While these results showed that MOCCA can anticipate most of user preferences, they do not clarify whether users would actually benefit from culturally adaptive interfaces in terms of work efficiency and satisfaction. Do users perceive MOCCA's personalized interfaces more intuitive and work with them more efficiently? Do they find them more appealing than a standard version? We evaluated these questions with 41 participants from 25 different nationalities who had previously lived in 2–5 different countries. Participants were asked to perform a set of tasks with MOCCA's "standard" US version, as well as with their culturally adapted version without knowing which user interface was their personalized one. The US version looks very similar to the Swiss version and mostly corresponds to Swiss preferences, as shown in our first study. According to conventional localization approaches where users either select their country of residence, or this is automatically detected based on their IP address, our participants would have received MOCCA's Swiss version, because all of them were currently living in Switzerland.

The results of this experiment confirmed our hypothesis: Participants performed the tasks 22% faster with their personalized version and made 69% fewer errors. These objective performance metrics were also mirrored in participants' ratings of the two versions, which show that the majority of participants thought that their personalized

a) Rwanda

b) Switzerland

c) Thailand

Figure 2 MOCCA's user interfaces for Rwanda, Switzerland, and Thailand.

version was more appealing and that they could work with it more efficiently. However, the closer participants were to the US culture ("Westerners"), the less likely they were to choose the personalized version over the US one, in line with rating both versions similarly high on aesthetics and usability.

5 Future Work

The approach presented here was the first to suggest an automatic adaptation of the entire user interface to a user's extended national culture, and many challenges remain. First of all, cultural adaptivity can be incorporated into any kinds of user interfaces but requires changes to the underlying source code, as well as the design of alternative version of different parts of the user interface. In the future, we aim to mitigate this initial investment by enabling an automatic adaptation of existing Websites based on a visual overlay that is presented to the user while she is surfing the Web.

Second, it will be interesting to investigate whether a more refined cultural background helps us to anticipate users' preferences more accurately. Evaluating this requires a high number of participants from all over the world with a large variety of other cultural influences, such as different education levels (which we controlled for in our studies). As such, studies like this necessitate online experiments, which risk that participants "game the system", or are distracted while performing a certain task. We are currently working on mechanisms to better control such remote evaluations in order to run large-scale evaluations of our approach in the future.

6 Conclusion

In summary, the results of our experiments supported the idea that preferences for a certain look & feel of user interfaces differ. Cultural adaptivity has demonstrated to be a feasible approach to approximate these varying preferences, resulting in an increased work efficiency and a higher user satisfaction. Moreover, we were able to show that it is possible to anticipate users' preferences to a large extent *before* they start interacting with a Website. For international companies attempting to attract an international audience, the approach could therefore prevent online users to turn to the competition, and instead convince them to engage with their site.

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