Intercultural Usability of Large Public Displays

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ABSTRACT

One component of smart or major cities are large public displays that are used for many purposes - advertising, warning, informing. These devices appeal to a large heterogeneous user group as especially in major cities people from many countries and cultures live together. Even though, researchers have identified intercultural usability recommendations for general and private devices - mobile phones, websites, etc. -, there is still a gap of information about how to design large non-personal, public displays for intercultural user groups. This dissertation explores the challenges and opportunities within the intercultural design space of large public displays. The expected results are design recommendations and guidelines regarding relevant aspects for intercultural usability of large public displays. Further, these results can be used by user interface designers and researchers that want to design, improve, evaluate or further explore large public displays for intercultural settings.

CCS CONCEPTS

• **Social and professional topics** → **Cultural characteristics**; • **Human-centered computing** → **HCI theory, concepts and models**; *Usability testing*.

KEYWORDS

Intercultural Usability; large Public Displays; Design Guidelines; Intercultural Design; Human Computer Interaction

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1 INTRODUCTION AND PROBLEM STATEMENT

Why does intercultural usability of large public displays matter?

Nowadays, globalization and digitization of our world brings mankind closer. We explore the lifestyle of many cultures while traveling or working in other areas of the world. This new and popular lifestyle - to work and live within other countries or travel through various countries – is challenging as we encounter various cultural differences in our daily life. Those differences we experience in language, behavior, food, religion and as well in interaction and usage of technology forces us to need a kind of "mediator" [21] between our own cultural imprint and the foreign one. Having a look at technology usage, large displays start to appear more often in public, e.g. in public transportation, exhibitions, events, companies, universities. Because of their size, they appeal to a wide audience and allow multi-user scenarios. This thesis explores, how large public displays that are mainly used for information purposes can be designed to ensure usability for intercultural user groups.

If the user group of a large public display is intercultural – it consists of people from more than one cultural background – the intercultural influence needs to be considered during the design phase as culture has an impact on usability and acceptance [3, 5, 9, 10, 23]. Thus, the design should consider intercultural aspects and enable intercultural usage to encounter the impact on the perception and understanding as well as interaction with public displays. Many recommendations for intercultural design exist [4, 8–10, 14], but they do not distinguish between applications or interaction devices. Due to differences in interaction and perception, each technological device has specific requirements for its user interface to ensure usability. Thus, researchers already analyzed challenges and defined recommendations for private devices, such as desktop applications [1, 3, 4, 9, 21, 22], mobile devices [25] and other applications or components (e.g. bakery dough sheeter, automotive user interface) [11, 15, 20]. But, there are still insights and guidelines missing for the intercultural design of large public displays. The difference is that large public displays address a larger user group and they are often part of smart cities. Further, they are urban and non-personal objects in comparison to mobile phones or desktop applications. The interculturality within the design of large public displays requires a wide analysis and exploration to address its usability.

Within the next section, I summarize first findings from related work. Following, the outline of research questions and methods as well as planned evaluations and the expected contribution. Finally, I conclude with the stage of research and open topics for discussion.

2 RELATED WORK

Searching for a definition of "culture" proves to be a great challenge as this term is widely discussed from different points of view and with different granularity. The definition given by [19] fits this dissertation aim and describes culture as:

> "An image of common values, ways of thinking and acting of a group of individuals that contributes to the formation of this community. It influences the interaction with other individuals as well as the interaction with a group of individuals that contributes to the formation of this community. It influences the

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> interaction with other individuals as well as the interaction with technical devices. The common group values serve as a norm and thus for the orientation of the group members and as differentiation criteria to other groups. The common cultural identity of a group is usually reflected by a nationality."

In 1999, [13] provides a definition for "intercultural" that is relevant for this dissertation describing it as the result of observing at least two cultures and their differences. An example for intercultural research is the software or system platform internationalization. A discussion of the differences between "intercultural" and "cross-cultural" and further related terms is given by [7]. For a better classification of cultural differences, several researchers apply the cultural model of Hofstede [12] that includes the following six dimensions:

- Power distance index
- Individualism vs. collectivism
- Uncertainty avoidance
- Masculinity vs. femininity
- Long-term orientation vs. short-term orientation
- Indulgence vs. restraint

The following subsections summarize existing intercultural research projects for desktop applications, mobile devices and various other applications and devices.

2.1 Desktop Applications and Mobile Devices

For web design [1] identifies an approach that defines cross-cultural guidelines by applying a five step development process. It starts with the usage evaluation of design elements between cultures (e.g. Layout, Navigation, visual representation, color, text). Next, relevant design elements are identified following the organization of cultural as well as HCI factors. On this basis, the cross-cultural design guidelines are developed by combining the specific outcomes of the previous steps.

[4] provides an overview for intercultural usability, describing degrees of cultural awareness from [18] and showing examples of various website designs, focusing on the different forms of architecture, coloring, navigation and graphics.

Searching for recommendations regarding color selection, already in 1998 [3] provide a color-culture chart describing the colors' meaning in various cultures. For example, red symbolizes happiness in China, anger or danger in Japan, death in Egypt, aristocracy in France and danger or stop in the United States. Further, [3] display a process for the identification of cultural markers on websites. Those markers are website elements that are highly frequent in one cultural group while they are absent in others. Moreover, the authors state:

> "No longer can issues of culture and usability remain separate in design for the World Wide Web"

This shows, that culture was already a long time ago identified as important factor for usability.

Also on the basis of websites, [21] analyze how cross-cultural systems embody indirect intercultural encounters. Therefore, they analyzed website designs by applying cultural viewpoint metaphors [6] and matching them with classes of signs [17]. They conclude that depending on the degree (Peirce's topology of signs [17]), signs can help users to get closer to the other culture or even enable an intercultural experience.

A study of various product types – but still focusing mainly on desktop applications (e.g. word processing, spreadsheet, video conferencing, games, online banking, etc.) – was made by [22]. The aim was to identify, whether cultural background influences the user experience aspects for these product types. Therefore, they compared multiple study outcomes from Germany and Indonesia. They draw the conclusion, that there is a significant difference within the rating of user experience aspects. Anyway, it was identified that culture has a lower impact than individual differences. Further, it also showed that even though many types of desktop applications were analyzed, the type strongly influences the experience.

Regarding cultural differences in the user experience of smartphones, [25] conducted an evaluation using remote online sentence completion method. The research study identified differences in usability, context and meaning, aesthetic aspects, subjective feelings and identification.

2.2 Other Applications and Devices

An interesting intercultural evaluation was conducted by [15]. Within this study, Google standardized symbols were evaluated for a bakery dough sheeter. The researchers of this study followed an interesting viewpoint. They conducted the evaluation with people from the same country – assuming with similar cultural background as no further information was given – , arguing that the worldwide highly usage of Google signifies that Google symbols are intercultural. The evaluation concludes that over 20 % of Google icons showed a high degree of icon-to-function assignment. To validate their results and for further insights, they plan to conduct evaluations with an intercultural test group.

To evaluate the usability of grid computing applications (they share various types of computational resources in different locations and thus, are an intercultural challenge), [20] proposes a set of heuristics for evaluation purposes.

[11] describes the development of an intercultural automotive user interface / experience design by using agile methods. Within this research, culture specific requirements and international design decisions are used to design culture specific interactions in automotive context. The authors motivate that intercultural aspects need to be part of the development process of the design.

3 RESEARCH QUESTIONS

This dissertation addresses the following thesis: People from various cultures use large public displays differently. Thus, the design of large public displays must consider relevant aspects of interculturality to enable usability. Therefore, the design space including challenges and design recommendations for intercultural usability of large public displays will be explored. My overall research question is:

How can large public displays be designed to ensure usability for various users from different cultures?

There is a research gap of intercultural usability for large public displays as no guidelines for intercultural design of public displays

exist. Further, I defined sub-research questions that support the overall research aim:

What are relevant design challenges for intercultural user groups that especially need to be considered for large public displays?
For the beginning, I will explore the design space regarding intercultural usability of large public displays to identify aspects that differ or are highly relevant for this heterogeneous user group. After a first brainstorming session, a literature analysis will be conducted to identify existing solutions for various design aspects. Further, expert interviews or first empirical evaluations of the exploration will identify main challenges, that will be addressed in further analysis, design and evaluation phase.

Which design guidelines already exist for intercultural usability and large public displays?
To answer this question, an extensive literature analysis will be conducted in two phases. The first phase results in an overview of existing design guidelines focusing on intercultural design in various research areas. Following, the second phase identifies important considerations for the design of large public displays in general. Finally, both results will be combined to receive an overview of relevant design aspects from these viewpoints.

What could be an intercultural design for large public displays?
Reviewing the results of the literature analysis, heuristics for intercultural design and large public displays will be a part of it. These heuristics will be combined and adapted to meet the previously identified main challenges regarding intercultural usability of large public displays, similar to [20]. Based on the newly defined heuristic, the design of a large public display deployment will be adapted and further used as a prototype. An example of the currently deployed large public display – still not adapted to intercultural user groups – is displayed in figure 1 and is the starting point for my research.

How useful and applicable is the intercultural design?
To further evaluate the intercultural design, deployment-based research [2] will be conducted. Within this research phase, several evaluations will take place to identify potentials for improvement and suitability. The evaluation will follow an iterative approach as each study outcome will be used to adjust the design and thus, build the base for the next evaluation.

What are design guidelines and recommendations for two previously identified main challenges?
The result of the previous sub-research question is the foundation for the derivation of design guidelines and recommendations. Besides, a summary of open issues or uncertainties in intercultural design for large public displays and in intercultural evaluations will be given.

4 METHODOLOGY

Within this dissertation, I will follow the design science approach by Peffers et. al. [16]. For the beginning and the exploration of the research gap, relevant aspects of interculturability regarding large public displays will be identified by a brainstorming session

Figure 1: Example of our current large public display and its design interface.

and a subsequent literature analysis. Further, these aspects will be reviewed by conducting expert interviews or a first empirical study. The design and evaluation will focus on these identified main challenges for intercultural usability of large public displays. Moreover, an extensive literature analysis will identify existing design guidelines either in the field of intercultural usability or large public display design. During this review, diverse research results will be considered - not focusing on one device type only. The results of this analysis will derive relevant aspects for the design of an intercultural usable large public display. The next step is the design phase, starting with a review of existing heuristics and how those can be adapted for intercultural large public displays. Using the defined intercultural heuristics for large public displays, a first evaluation of our current large public display deployment (figure 1) will be conducted to identify potentials and issues for improvement. With those results, the development of a first draft for the intercultural user interface will be conducted. To demonstrate and evaluate the design, a setting will be built up, were evaluations can be conducted in the field (deployment-based research [2]). The intercultural design will develop iterative by conducting various evaluation phases including an adaption of the design according to the evaluation outcomes after each phase. This follows the user-centric development approach. As a result of the evaluations, design recommendations and guidelines for intercultural usability of large public displays will be published. Further, a summary of open challenges and ideas as well as observed issues during evaluation will be summarized to provide an overview of possible future research projects.

Here is an overview of the planned research methods:

- Literature review: explore research gap and main challenges, identify existing design recommendations and guidelines for intercultural usability and large public displays, derive heuristic
- Heuristics: identify improvement for an existing deployment
- Prototype of an intercultural design challenge for large public displays
- Evaluation (deployment-based): Verification and improvement of the design challenge

5 EVALUATION APPROACH

The evaluation of the intercultural design addressing previously identified main challenges consists of several phases, applying various evaluation methods. The methods will be chosen depending on the design challenge. After each study, adjustments are made to the design to iteratively improve it. To ensure interculturality within the test group, a data collection of the cultural background will be required. The objective of the evaluations is to identify whether the design is an appropriate solution for the main challenge and where there is still room for improvement. Specific evaluation details can only be usefully defined after the main challenges have been identified.

Many settings for evaluation purposes exist. For example, a large public display can be installed at a bus or metro station, within social areas of companies, academic institutions, shopping malls, exhibitions or conferences. Within our academic institution there is the opportunity to use a network of large public displays that we manage and use to inform students, employees and guests about our department, news in various research areas and up-to-date publications. One deployment is displayed in figure 1. As we put a lot of effort in the management of our public displays on campus, we should not disregard, whether foreign students or employees with other cultural background can use and profit from them such as we do. Especially, when we place large public displays in areas that are commonly used by foreign persons (e.g. international office at university). As [24] shows, within the academic years of 2003 to 2018 / 2019 the percentage on average of foreign students at German universities rose to the peak of currently about 13.8 %. So far, I plan to use a setting within the academic institution and investigate alternative places for evaluation purposes.

6 EXPECTED CONTRIBUTIONS

This dissertation aims to contribute to the research within the area of intercultural design, usability and large public displays. Further, user interface designers may use the results to improve their design regarding interculturality. Moreover, I will gather information about evaluations with intercultural user groups that may be used for further research purposes.

7 STAGE OF RESEARCH AND OPEN TOPICS FOR DISCUSSION

This research is in an early stage. Currently, the exploration of the main challenges takes place. Open topics that need to be discussed are the main challenges presented below, as well as evaluation scenarios and methods. First ideas of challenges regarding intercultural usability were gathered and are displayed in figure 2.

But, why are those challenges interesting for intercultural usability of large public displays?

Looking at the interaction possibilities of large public displays, there could be a difference in interaction preferences between cultures. In the case of multiple cultures using the display at the same time, it is important to find out: Which interaction method is universally valid or how multiple interaction possibilities can be enabled?

Thinking about the visualization of content on large public displays, cultural imprint influences perception and understanding.

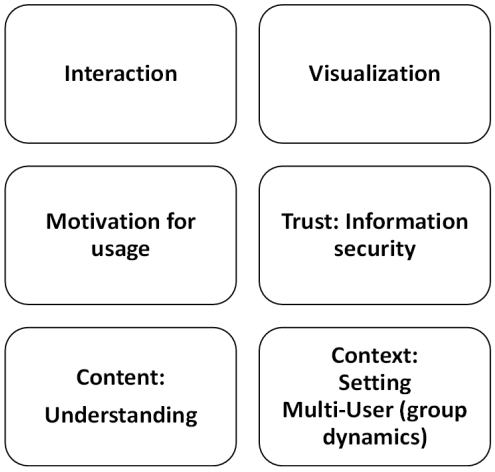

Figure 2: Challenges regarding intercultural usability of large public displays.

For example, color interpretation and variety, speed of moving objects, reading direction, information density or design of symbols are a few examples of visual elements that need to be analyzed and redesigned for intercultural user groups.

As technology usage varies between cultures, the motivation for usage differs as well. For the deployment of large public displays it is already a known challenge to achieve good usage numbers. The analysis of usage motivations of various cultures can identify potentials and finally increase usage numbers.

Trust in information security and data privacy is differently pronounced between cultures. The selection of information displayed on large public displays is generally critical with regard to information security. If personal data is involved, data protection regulations must also be taken into account. The security awareness regarding personal data, but also company data, is differently pronounced in several cultures. How do you deal with the different levels of security awareness of an intercultural user group?

A more general issue is the interpretation and understanding of content, which varies between cultures. Already a different understanding of terms, is a big challenge if you want to create a common understanding or level of information. Therefore, the question arises, which content is suitable for the conveyance of information or are extremely susceptible to misunderstandings due to cultural influences?

The context of large public displays also poses a challenge for intercultural usability. This refers, for example, to the setting of the display, which should support intercultural use. Since public displays are designed for open spaces, some cultures may feel insecure about using the display and being observed by several other cultures. How could the environment of the display be chosen or designed so that it is usable for intercultural user groups? Another challenge is multi-use that can trigger group dynamics. Especially the group dynamics of intercultural users pose challenges due to different communication habits. How can a large public screen be designed to support group dynamics between intercultural users and possibly act as a mediator in between?

BIOGRAPHY

Laura Stojko has been a PhD student at the Universität der Bundeswehr München in Germany since 2019. She is part of the research group for Cooperation Systems Center Munich (CSCM). She is particularly interested in research on the cultural influence on technology usage. Her advisor is Prof. Dr. Michael Koch, Head of the professorship for human computer interaction. She plans to finalize her dissertation around 2024.

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