Asia Pacific
Academy of Science Pte. Ltd.

Original Research Article

Development of mobile application prototype for smart tourism based on user-centered design

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ABSTRACT

In this paper, the implementation of ISO 9241-210:2010 (Human Centred Design for Interactive Systems) standard for the development of a mobile application is presented in order to strengthen the user experience when using the mobile application in situ. Following the phases that the standard dictates for the development and evaluation of software and hardware in order to obtain a working prototype, and at the end of the process a product. The implementation of the standard allowed to generate an initial prototype validated by real users (tourists), so that, for future work will be carried out using artificial intelligence (AI) techniques and data analysis, these same, will complement this work, resulting in a fully validated and functional application for Smart Tourism. It should be noted that the purpose is to use User-Centered Design (UCD), thus achieving a high-fidelity prototype.

Keywords: mobile application prototyping; user-centered design; Smart Tourism Destinations; smart tourism

1. Introduction

The constant development of technologies and the mobility provided by data networks, cause the tourist to modify the way in which he organizes and enjoys a trip, which also leads to the evolution of tourism products and services, thus creating the concept of Smart Tourism Destinations (STDs), which considers aspects related to sustainability, accessibility, knowledge and technological innovation around tourist destinations[1]. For the development of an STD it is necessary to provide intelli-gence to the infrastructure of the tourist destination, thus promoting efficient and sustainable development and increasing the quality of life of residents and visitors, it is also important to consider aspects related to the collection, analysis, processing and visualization of massive data, i.e. Big Data, in order to offer better products and services to tourists; the added value provided by the concept of STD is the consideration of the visitor/tourist as the center of this[2]. STD's are the result of the application of Smart Cities principles to the tourist destination and, with this, the birth of the Smart Tourism concept, so called due to the ubiquity of smart devices and the

generation and visualization of diverse information about the urban environment in real time and available anywhere in a city[3].

In order to address the previous considerations, this article presents the development of a prototype of a mobile application for Smart Tourism based on the User-Centered Design process (ISO 9241:210)[4], which allowed the development of the prototype considering the tourist as the center of the design, development and evaluation of the same.

2. Theoretical foundation

The User Centered Design (UCD) process "is a software design methodology that helps designers/developers to create applications that meet the needs of users"[5] see **Figure 1**. The objective of the UCD process is to verify whether the products developed "in their different stages" are easy to use and lead to user satisfaction and meet the objectives of the organization or company[6]. As mentioned in the previous section, the UCD process was implemented with the purpose of complying with the generic principles for interface development, e.g., making it easy to determine what actions are possible to perform at each point in the application, making things visible, making it easy to evaluate the current state of the system, among others.

On the other hand, and with the purpose of providing the tourist with an already functional application for smart tourism, as future work, various techniques of intelligent data collection, analysis and processing have been considered, e.g., it is possible to obtain large amounts of data from social networks e.g., Facebook, Instagram, Twitter and perform an analysis of comments (positive, negative and neutral), has tags and photo postings of a given tourist destination. Techniques such as sentiment analysis[7], which will help in processing and filtering relevant information "in situ" to the tourist. In Bangladesh, there is a tourism application that has machine learning as a principle[8], an application based on artificial intelligence and continuous data analysis, as for its design, the author proposes an interface based on the UCD, based on a design similar to Google Maps, since, as such, it is recommending intelligent routes.

It is important to mention at this point that this article presents the first part of the development of the solution and/or intelligent service to the tourist, that is, the prototype of the user interface based on the UCD process. **Figure 2** shows the model to be implemented for the processing, analysis and deployment of information in the mobile application for smart tourism.

As can be seen in **Figure 2**, the process model is integrated by six stages that will enable the development of a mobile application solution for smart tourism. In this paper we will focus on the last stage (Data visualization), since this is where the UCD process will be used.

3. Methodology

As mentioned above, for the development of the smart tourism application prototype, the UCD process (ISO 9241:210) was used[4]. The following is a brief description of the DCU process, see **Figure 1**.
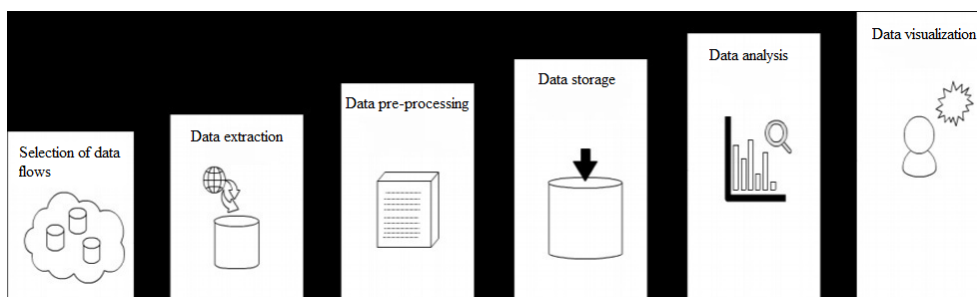

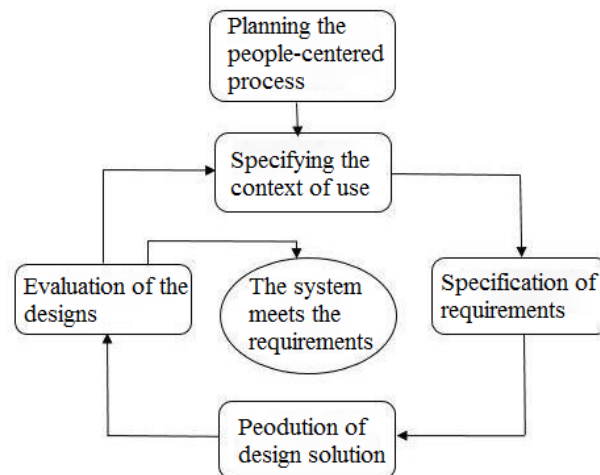**Figure 1.** Analysis process model defined for data analysis and data visualization implementation[9].

Figure 2. ISO standard: 9241-210:2010, ergonomics of human-system interaction, part 210 human-centered design for interactive systems[4].

DCU process phases:

(a) Specification of the context of use. Identification of the people who will use the product, what they will use it for, and under what conditions they will use it, i.e., in what context and where they will use it.

(b) Requirements specification. Identification of user needs and objectives, as well as organizational and product usage requirements.

(c) Creation and development of design solutions. Based on the information gathered in the two previous stages, the designs are carried out. Depending on each case, this activity can be broken down into different sub-stages.

Evaluation of the designs. This is one of the most important stages of the process, in which the designs are evaluated taking into account the people who will use them, as well as the requirements and the context of use. If the evaluation satisfies the requirements, the process is finished; if not, the process is repeated from the first stage, refining the results obtained.

4. Implementation of the user-centered design process

The implementation of the UCD process for the development of the prototype mobile application for smart tourism is described below:

4.1. Specification of the context of use

In order to specify the context, in this stage the techniques of inquiry in the context, ethnographic study field observation were implemented, with them it was possible to identify and describe the target users.

4.2. Requirements specification

For the collection of requirements and their specification, in this stage, the survey technique was implemented, which allows obtaining quantitative information[10]; Google's "Formulários" tool was used to generate a survey of 14 online questions that allowed obtaining general data (name, age, sex, among others) and specific data (e.g., preferences among social networking apps) for the design of the application. The survey was applied to a sample of 63 people (national and international tourists), with an age range of 15 to 70 years. The results obtained showed, e.g., that the application most used by tourists is "Google Maps' with 87.7% of those surveyed (see **Figure 3**), also, they did not know if the state of Zacatecas had any application for tourists visiting the city.
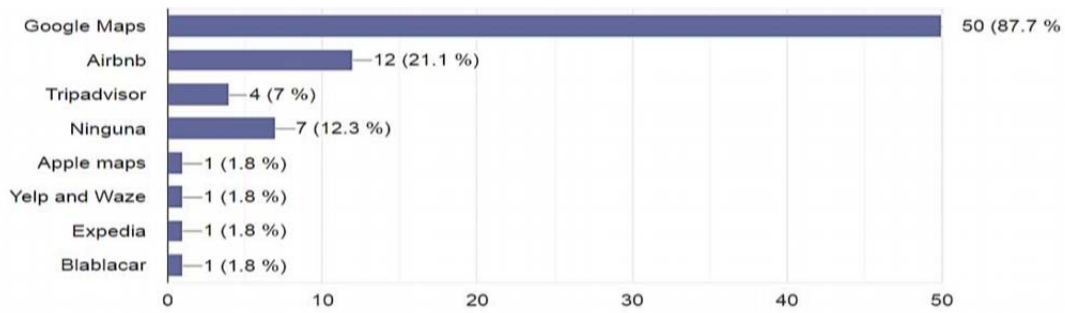
Figure 3. Histogram of the apps most used by users when traveling.

Likewise, a Likert scale was used to know the acceptance of the users for certain functionalities of the application, considering as good acceptance from 8 to 10 on the Likert scale, adding the percentages, which resulted in 80.6% of acceptance for the app to display notifications of tourist places near the location (see **Figure 4**), 87.7% to have notifications of the most popular places (bars, hotels, restaurants) in Zacatecas (see **Figure 5**) and 68.9% where they can see experiences of other users (see **Figure 6**).
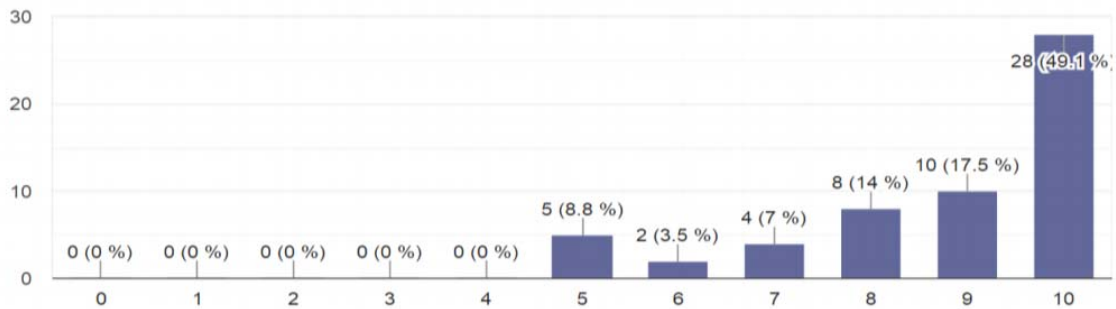

Figure 4. Likert scale of opinion on notifications of tourist places near the location.
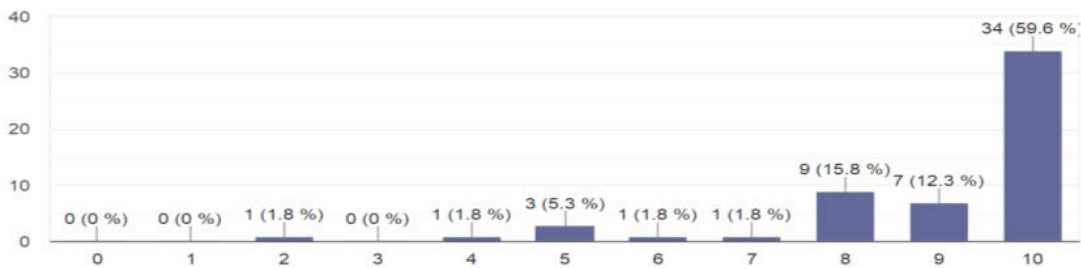

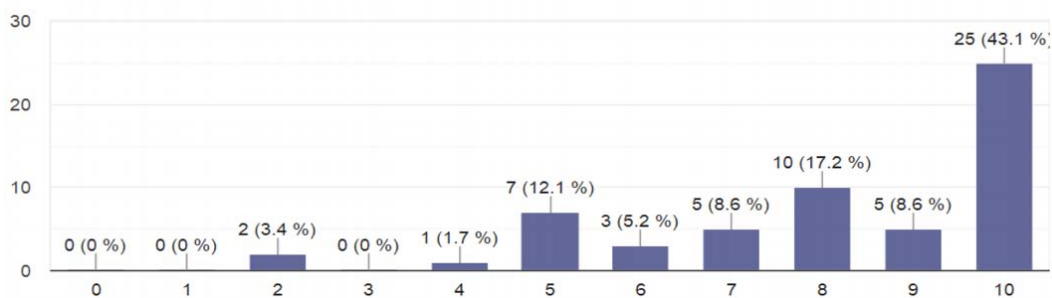**Figure 5.** Likert scale of opinion on notifications of crowded places (bars, hotels, restaurants).

Figure 6. Likert scale of opinion on notifications of experiences of other tourists.

4.3. Creation and development of design solutions

Based on the information obtained, the designs were carried out. Balzamiq[11], a software that allows the creation of low-fidelity prototypes, which are a

low-cost alternative for participatory design and evaluation, was used for this purpose. Low-fidelity means that the prototypes to be used do not have the real aspect of the interface being evaluated, even though they operate in the same way[12]. **Figure 7**, shows the initial prototypes of the application for Tourz App.
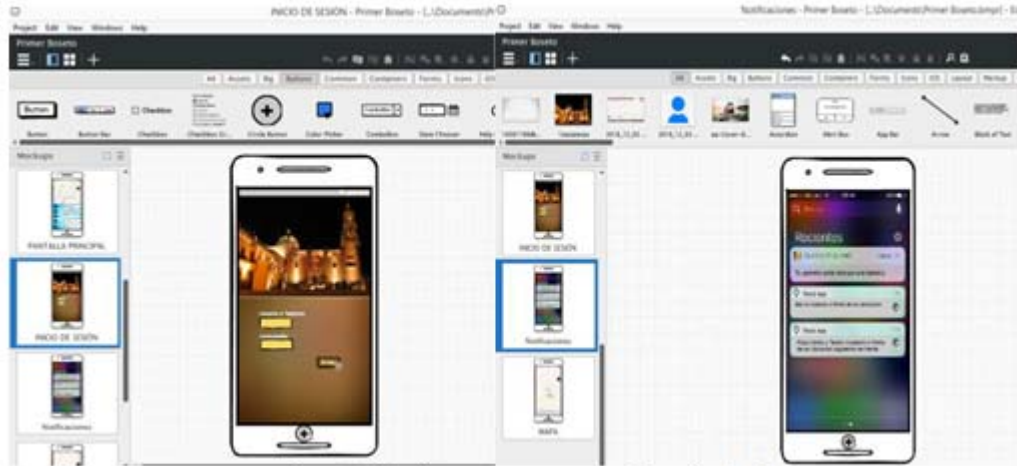

Figure 7. Initial prototypes Tourz App, Balzamiq[11].

4.4. Evaluation of the designs

To perform the evaluation of the initial prototypes, the Justinmind software[13] was used, with the purpose of providing some (simulated) functionality and to give the user a real perspective of the possible functioning of the mobile application. The simulation of the Smart Tourism mobile application prototype was installed on a Smartphone (see **Figure 8**).
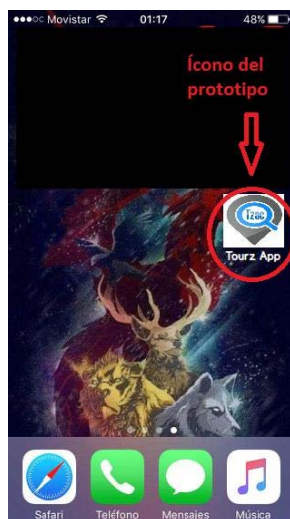

Figure 8. Tourz App icon.

The application was evaluated from the perspective of usability testing with real users and using a digital prototype. The usability test was carried out in the historic center of the city of Zacatecas with the participation of people of various ages and different places of origin (locals, foreigners and foreigners), see **Figure 9**.

Figure 9. Evaluation by users.

In **Figure 9**, users are shown interacting with the application prototype; at the end of their interaction, a survey was implemented, with the purpose of obtaining feedback, according to their experience of use. The comments focused mainly on the following observations:

(1) Improve the design of buttons.

(2) Change the startup presentation.

(3) Change design colors.

(4) It is intuitive and complies with usability principles.

Based on user feedback, the mobile application prototype was redesigned considering user recommendations (see **Figure 10**).

Figure 10. Screenshots of the final evaluated prototype.

As mentioned above, the final product is intended to incorporate intelligent and machine learning techniques that allow the tourist to be informed "in situ" by collecting, analyzing, processing and displaying useful information.

5. Conclusions

This article presents the development of a prototype of a mobile application for smart tourism, based on the User-Centered Design process, the prototype was evaluated through a usability test, and the feedback obtained allowed to generate a second version of the prototype validated by real users (tourists). Additionally, it is mentioned that in order to develop an intelligent solution that differs from those available in the community, intelligent and machine learning techniques will be incorporated for the analysis, processing and display of information.

As future work, it is intended to implement artificial intelligence and machine learning techniques to provide a smart tourism mobile application and then re-test it from the perspective of user-consumer and expert user experiences.

Conflict of interest

The authors declare no conflict of interest.

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