Conceptual Model of User Experience for Personalization

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Abstract. Designers of Information Technology (IT) devices and Information Systems (IS) are more and more concerned about providing better conditions of use: more efficient interactions, enjoyable interfaces, and personalization. These aspects are studied within the concept of User Experience (UX). UX is necessarily specific and should be dynamically adapted to a given user or group of users. Personalized user experience links with the user's characteristics, user's mood, and user's expectations but also with the targeted object under a UX design process. In addition, in many cases, multiple devices are involved in user interactions. In the context of museum devices, visitors use tablets, interactive screens, geolocation sensors, headphones, etc. These devices are also supporting the IS dedicated to visiting applications. In general, the IS is not shared among users or very few of them. To provide personalized UX, we advocate building a shared IS supported over users' devices and back-office servers. Thus, we can introduce a conceptual model to help UX personalization. Our model proposal is illustrated through Man-Museum Interactions literature.

Keywords: User Experience · Conceptual Model · Personalization · Man-Museum Interaction

1 Introduction

Information and Communication Technologies (ICT) overwhelm everyday life to provide an enhanced form of living. Digital extensions to our common senses are flourishing essentially based on a more connected world. Connections encompass humans, objects, homes, cars, pets, cities, organizations, industry, banks to offer a smarter life. The key concept of this new era is interaction. As a wide concept, it is fostered through Information systems engineering, Communications, and more and more efficient Technologies to deliver an improved User Experience (UX).

We believe that valuable user experiences need to be designed carefully with all dimensions of user context, thus, UX is implicitly personalized. Due to the changing nature of user context, especially when emotions are entering the loop of the design process, UX is necessarily specific and should be dynamically adapted to a given user or group of users. Dynamicity should consider time, space, and the user's profile. We assume that the profile is not uniform, it is a time-dependent concept. It is evolving through time

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and is influenced by all sorts of occurring events. Personalized user experience links with user characteristics, mood, and expectations. It also links with the object under consideration by the UX design process.

In addition, in almost all cases, multiple supports (devices and/or associated IS) take part in a user experience. This is the case with devices used in museums. We aim to provide the adaptation of these devices to different visitors, for instance, if a child is close to a screen, this one should show images attractive to the child. If the visitor is an adult, the presentation on the same screen could be more serious. For an elderly person, the font size could become bigger. The personalization could be done at an individual level, but also for a persona (user type). The same issue is present in organizations when users (employees) connect to different tools in their workplace and could have a personalized representation of available data.

To obtain this personalization, data about users and user experience should be stored and shared between different devices and supported by the IS of the organization. Despite numerous works on UX, we have not identified a conceptual model allowing to structure the required data. Thus, the goal of this paper is to present a UX conceptual model reflecting the different UX dimensions and used to personalize UX. In our work, we consider user experience only supported by digital technologies.

To validate our model, we have been interested in heritage applications; the Museum came rapidly to our mind as a convenient use case. Museums offer emotional visits, and most of the applications developed for museums could be, by design, obsoletes at the time they are launched. The missing point is evolution. Visitors change and what they feel too is changing. Artifacts move from one place to another (sometimes to another museum). Temporary events are programmed to underline an artist or a piece of work… This is a very preliminary list of the kind of evolution a museum should face. Any change is a risk for the launched application because it can be unable to reconfigure to take into account changes. Applications for museums should be designed in a different way. The challenge is to provide a model that supports changes over time and that the applications that rely on this model can evolve accordingly to these changes.

The paper is organized as follows. Section 2 introduces related works. In Sect. 3 we present the UX conceptual model. In Sect. 4, we illustrate this model with the Man-Museum interactions literature. We conclude the paper and give our future research in Sect. 5.

2 Related Works

In this section, we present works related to user experience in general and applied to Man-Museum interactions.

2.1 User Experience and Its Representation

As defined in ISO 9241–210, “User Experience is a person’s perceptions and responses that result from the use or anticipated use of a product, system or service.” (definition from [1]). All works on UX agree on the complexity and richness of this term [2–5]. [2] defines three facets in UX: “beyond the instrumental”, “emotion and affect”, and the

"experiential" (which means context-awareness and temporality). [3] enumerates different definitions of UX. [4] shows results of a Systematic Literature Review on aspects and dimensions of UX with the main goal of UX evaluation. The authors have identified five dimensions: values, user needs experience, brand experience, technology experience, and context. [5] presents a survey on the UX nature to obtain a shared definition that converges on UX as "dynamic, context-dependent and subjective" [5]. They detail different kinds of experience: product, system, service, and object experiences.

The most detailed generic definition of UX is done in [1]. The authors present a product-oriented model of user experience. It includes the following dimensions: human perception (senses, cognition and affects, and responses), product (product sensors and product responses), experience context, and temporality of experience [1].

Considering the UX representations, the authors of [6] suggest and validate a mathematical model of UX in the case of dynamic adaptive video streaming. The authors of [7] develop a simplified model of User Experience to explicitly link UX with usability and Human-Computer Interactions. A temporal model of the UX lifecycle is highlighted in [8] with an explanation of different UX phases.

More detailed works on personalized UX are [9] and [10]. [9] presents a three-layers contextual gameplay experience model linking the player (with his experience corresponding to player characteristics and internal influences) to the game system (playability), and external influences (called contextual gameplay experience). External influences include spatial, temporal, social, and cultural influences. In [10], the authors detail a UX model, which includes product features having an apparent product character for each user. The user is subjected to different consequences of the apparent product character depending on the situation. The authors apply their model to augmented reality in the case of urban heritage tourism.

2.2 User Experience in the Context of Man-Museum Interactions

User experience with application to Man-Museum interactions is presented in [11–18]. The authors of [11] present a study made at the Acropolis Museum and, in parallel, in social media networks. The goal of this research is to explore personalization in the museum experience. [12] analyzes different approaches to understand visitor behavior and defines the following perspectives: socio-cultural, cognitive, psychological orientation, physical, and environmental. [13] doesn't focus on visitors' behaviour but on visits and visitors' motivations to explain why people are coming to museums. The expectations are compared with the visit itself. This work leads to a classification of visitors: Explorers, Facilitators, Experience Seekers, Hobbyists, Rechargers, Respectful Pilgrims, and Affinity Seekers. [14] presents a framework architecture to support three visit phases (pre-visit, on-site, and post-visit). This framework contains three models: visitor model, site model, and visit model. [15] suggests using recommendation systems to take care of visiting styles in addition to user interests to improve the quality of museum visits. [16] details a multi-sensory approach to design the museum experience. Several works detail serious games developed to improve Man-Museum Interaction, such as [17, 18].

We observed multiple works mentioning the necessity to have a shared vision of UX, suggesting definitions and aggregating information about different aspects of UX.

However, from the literature review, we have not identified a conceptual model covering the different dimensions of UX and allowing to personalize UX in a distributed environment. In the next section, we present a UX conceptual model.

3 Conceptual Model of User Experience

Figure 1 depicts the UX conceptual model. This model features different UX-related dimensions. Senses, affects, responses, and context are the basic components that could be considered as input/output to feed the user experience. User experience is related to the corresponding objects (which are used in a specific experience) and subjects (that we foresee larger than the concept of a simple user). It is also connected to a device which is represented by an ICT component used in the experience. User experience could be expected (by the user or by designers) and lived during the experience. In the following, we explain all these concepts.

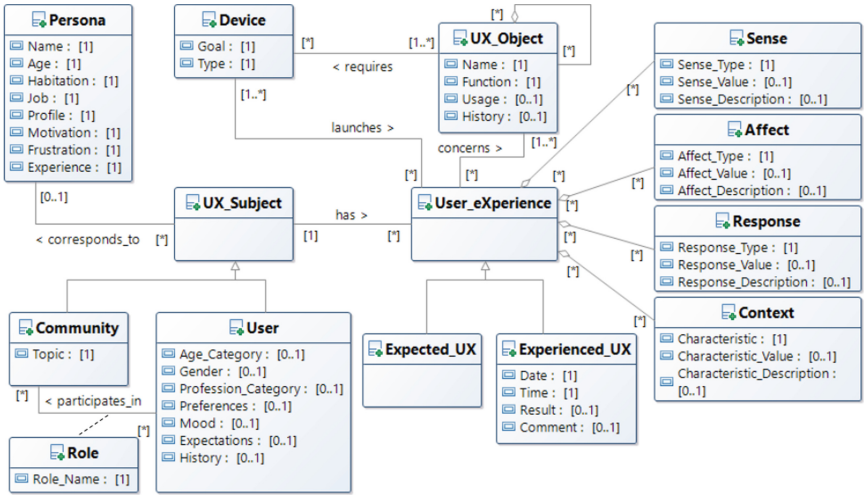

Fig. 1. User Experience Conceptual Model.

User_Experience. UX expresses an experience of a user toward an object. A user experience is unique for a user and for a time slot, but it could be associated with one or with a set of objects. This is the core concept as we consider that users communicate with objects through user experience. The UX concept is composed of four related concepts: sense, affect, response, and context (the four *composition* links) each of them representing a detailed taxonomy of possible elements. UX is a combination of different possible values of the taxonomy elements. The user experience *concerns* at least one object but could be associated with many objects. Each object is associated with multiple user experiences. Each user experience is associated with only one UX subject (the *has* association).

Sense. The typology of senses is taken from [1] which distinguishes the following types: exteroceptive (external to the organism stimuli), proprioceptive ("spatial body orientation"), interoceptive ("stimuli produced within the organism"), and chronoception (sense of time). Different senses are sight, hearing, taste, smell, touch, thermic, pain, and so on. **Affect.** Affects (lived emotions, values, etc.) as cognitive processes "link external stimuli information with brain… in order to reach an interpretation of the stimuli on their semantic and aesthetic character" (from [1]). **Response.** Human responses include physiological, motor, and motivational affects [1]: temperature sensation, respiration change, cardiovascular change, posture, gesture, mimic, voice, etc. **Context.** The context factors are inspired from [19] as better reflecting the context content: external context (like weather, season, time), organizational context, etc. For each of them, the model allows to identify the *Type* and to specify a *Value* or a *Description* of the given characteristic. For instance, for a cardiovascular change, we can register the corresponding value, or for an emotion or a value (as an affect), we can give a description.

User Experience. As in [20], we consider two kinds of UX: expected and really experienced (the *inheritance* associations). The instances of **Experienced_UX** store data about real UX together with data about this experience: *Date*, *Time*, and possibly *Result* (for instance, a "like") and *Comment* if they are left by subjects. In addition, a UX subject has expectations concerning his/her future user experience. Thus, an instance of an **Expected_UX** could be defined.

UX_Subject. UX_Subject could be a User of a Community (the *inheritance* associations). Both could *correspond to* a concept of Persona mainly used to characterize users in this field. A UX subject *has* multiple "user experiences".

User. "A user is a human who is targeted to utilize a product" [1]. Users have different parameters describing them: *Age_category*, G*ender*, *Profession_category*, *Preferences*, *Mood*, *Expectations*, and *History*. Only data authorized by the user could be stored respecting the General Data Protection Regulation (GDPR) rules.

Community. A community represents a group of users identified within a friendship network and is mainly characterized by a *Topic* and people *participating in* it [21] expressed with an association class **Role**. Users can have various roles in different communities (*Role_Name*).

Persona. The Persona term is related to a type of user often an imaginary one but deduced from data gathered during the exploration of users. [22] defines a Person as a "representation of the most common users, based on a shared set of critical tasks." A Persona describes different characteristics, needs, and behavior of this typical user. This concept is central to the users' representation in UX-related approaches. It includes generally demographic and biographical data: personal, technical, relationship, and opinion information [23]. The authors of [24] present a detailed ontology-based user characterization using the concept of Persona to personalize UX applications depending on context. We take the most important characteristics in our model (*Name*, *Age*, *Habitation*, *Job*, *Profile*, *Motivation*, *Frustration*, and *Experience*), but this list could be extended if needed in a given case. A persona could be associated with a unique user or with a community.

UX_Object. Each UX is related to at least one UX Object. We use this generic term to group products, services, systems, or objects of experience from [5]. Users can experience a whole group of objects, for instance, from a museum room without differentiating concrete objects (the *composition* link on the UX_Object concept). Different attributes characterize UX Objects. An object is not only the physical object itself but a set of relevant data about it: history of creation and of evolutions, author(s), way of production, uses, civilization it belongs to, maintenance events, etc. These aspects are revealed using ICT devices, augmented reality for example. It can include variations in colors, texture, sounds, forms, and so on. We define the main attributes: *Name*, *Function*, *Usage*, and *History*. This list could be extended obviously.

Device. A device supports the user experience itself. The nature of the device could be different from communication devices (smartphones, tablet computers, glasses, VR masks) to sensors used to capture gestures, movements, eye tracking, and so on. At least one device is required to represent a UX Object, but it could be done by multiple devices. [1] enumerates types of sensors that could be associated with a consumer product: physical, logical sensors, sensors capturing external factors (contact, range, vision sensors), internal factors (like heat monitoring), and so on. We characterize devices by two main attributes: *Goal* and *Type*. An object *requires* to have supporting devices, each device could support one or more object(s). A device could contribute to multiple user experiences (the *launches* association). The user experience should have at least one associated device (for our purpose, we do not consider UX without any technology-based support).

This conceptual model of User Experience aims at highlighting different UX-related dimensions that we can store in IS for further data utilization to personalize the experience. In this manner, data about UX are centralized and standardized. It helps also to compare the planned and real experience. In addition to these practical needs, the introduced conceptual model contributes to several challenges (based on [25]): to formalize UX knowledge through different concepts and their relationships; to develop a shared representation of UX concepts; to make UX knowledge reusable in different projects and contexts; to support the creation of UX models applied to various fields, and to check and validate the existing UX models or other representations.

4 UX Conceptual Model in Man-Museum Interactions Literature

Museum IS are often database-oriented (collection management systems – [26]). In [26], the author suggests an approach to integrate five museum legacy information systems applied to the case of the National Palace Museum in Taiwan. [27] presents an Internet-of-Things architecture to design smart museums. Except for [14] and [20], we did not identify any other work dealing with a conceptualization of UX in the context of Man-Museum interactions. [14] presents the visitor, site, and visit models. [20] presents a model of the Visitor-Player experience. In this work, the visit game personalization is thought as a resolution of puzzle intrigues between external components (playability and context) and players' expectations.

We apply the UX conceptual model to Man-Museum Interactions as they are considered in the current research literature to identify related works depending on the established concepts.

User Experience. The main research sources dealing with UX in museums are [11–16]. User experience in museums is considered as containing three phases: pre-visit, on-site visit, and post-visit [14]. [20] details the notion of museum visit experience to define balanceable visit games. This work also distinguishes between expected and really lived experiences.

Sense, Affect, Response, Context. These UX components are less studied in the literature. [16] presents a multi-sensory transformation approach to enhance the museum visit experience. [20] defines four groups of contexts: museal, temporal, cultural, and social.

UX Subjects. Museum users are studied through the "Persona" concept. "Personas are detailed descriptions of imaginary people constructed out of well-understood and highly specified data about real people" [28]. Different approaches consider individual visitors [29–32], groups [14, 33], or both [34, 35]. Several works detail user characteristics. The visitor model form [14] includes a visitor profile (demographics and preferences), his/her state, together with the number of visitors in a group. [36] gives an overview of identified user characteristics from literature such as user profile (age, gender, education, skills, and so on) or user preferences (related or not to the museum context). Several approaches also consider the feedback of the user after visiting the museum.

UX Objects. Different museum objects, art pieces, etc. A group of objects can be an exhibition room or a logical group of objects like Lavoisier Lab (https://www.arts-et-metiers.net/musee/visitor-information) representing a set of objects which have a real additional value when presented together. Several works mention objects attributes as factors for visit personalization: available multimedia information (graphical, video, audio, etc.) regarding the artworks [34]; multimedia collection containing digital reproductions of sculptures, educational videos, audio guides, textual and hypermedia documents with a description of authors and sculptures [37]. In addition, several museums and other cultural heritage institutions detail various characteristics about museum information considered during user experience: museum map [29, 34], repository of cultural heritage data [30], and exhibitions' locations [31].

Devices. The most detailed typology of devices used in museums is given in [38]. The author enumerates more than 50 devices grouped into 13 categories like handling devices, viewing devices, projection devices, etc. [36] summarizes devices used in different projects dealing with museum user experience: PDA (personal digital assistant) devices with RFID (Radio Frequency Identification) tags [34, 35], mobile devices [11, 14, 29], glasses [32], sensors [32], etc.

In addition to the identification of main concepts, the application of the UX conceptual model to Man-Museum Interactions allowed us to identify the following open issues: (i) lack of UX conceptual models formalized to represent Man-Museum interactions; (ii) UX components are under-explored and personalization mechanisms are still limited for Man-Museums Interactions; and (iii) devices used in Museums are not related to their information system.

5 Conclusion and Future Works

Currently, different kinds of organizations start to apply UX to promote their activities and to improve the relationships with their users: customers, visitors, and clients. For example, it can be refined as customer experience or brand experience [5]. To help them in establishing an IS for implementing shared data about UX, we presented in this paper a conceptual model allowing to store data about UX and to share information about how UX could be personalized for a given user. The proposed conceptual model offers a shared representation of UX and allows checking the completeness of the UX-related concepts of a real application. We have applied this model to UX in Man-Museums Interactions.

In our future research, we will develop a generic method for engineering unique personalized UX, which could be applied not only in the case of visits in museums, but also in the case of employees' experience within digital workplaces. We foresee the engineering of adaptable, personalized experience as situational, thus depending on different characteristics of the context.

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