A framework for responsive environments

A Framework for Responsive Environments

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Abstract. In this paper, we define Responsive Environments as adaptive venues that possess context awareness, deliver ubiquitous computing and natural interaction. They also yield a pre-determined User Experience. We propose a framework for the development and assessment of such environments and we discuss applying the framework to some examples. Highlighting benefits and usefulness of the framework.

Keywords: Ubiquitous computing · Pervasive computing · Ambient intelligence · Responsive environments · User experience · Design and evaluation framework

1 Introduction

Responsive Environments (ResEnv) are venues augmented with interactive technologies and enriched with digital content. They were defined as spaces enhanced with media and technology to provide a user experience (UX) that is interactive, rich, and changing; being engaging with their visitors and adaptive to them [1]. Our main motivation in developing ResEnv is to crate a comprehensive experience, which combines ubiquity, ambience and pervasiveness. We believe that ResEnv combine the functionalities a space should provide, with the desired user experience, relying on interactions that are meaningful for the users, yet simple, without the urge for "more" – and unnecessary – complexity [2–4].

To clarify the concept of Responsive Environments within a contemporary context, we list comparable research areas in Table 1. These areas of research are about distributed information and communication technologies (ICT) as well as interaction channels, creating a digital ecosystem that surround the user. All of Ubiquitous Computing (UbiComp), Pervasive Computing, Ambient Intelligence (AmI) and ResEnv rely on a combination of media, modalities, interactions and technologies. However, only ResEnv includes a spatial and architectural embodiment as an essential component. Another key difference is that the constituent elements of each of these approaches have different prominence, priority, and level of engagement with the user. UbiComp prioritises the availability of information, Pervasive Computing prioritises the optimal use of technology in integration within objects and devices; as for AmI, it makes use of

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Table 1. Research areas related to responsive environments

Research areas	Main focus
Ubiquitous computing	Information technology – information is accessible, present and surrounding the user, relying on a collection of devices
Pervasive computing	Technology everywhere – computing is embedded into everyday objects and devices
Ambient intelligences	Content everywhere – the whole surrounding (i.e. all the physical objects used) is enhanced with digital content
Smart environments	More comfortable life – an environment of connected and interacting devices in an ordinary setting for everyday tasks
Responsive environments	User experience everywhere – the user experience the venue in a designed way

technology and information availability to provide content that has an effect on the entire environment. UbiComp relies on a push of information through the use of technology implemented on platforms of different sizes [5, 6]. Pervasive Computing prioritises the minimizing and hiding of technology to provide content and functionalities [7]. It is a disappearing technology that supports mobility and is in part worn/held by the user and in part embedded in buildings. To do so, Pervasive Computing relies on smart spaces, and a stable and scalable interaction [8]. AmI on the other hand relies on distributed integrated technology into everyday objects and deliver "social interaction" [2]. While information, content and technology are building components of ResEnv, in similar fashion to AmI. However, in the case of a ResEnv, it is the user experience that guides the design process and is the major focus of attention.

1.1 A Short Historical Perspective on Responsive Environments

American artist and researcher Myron Krueger is one of the early pioneers in the field. He took the implementation of media within spaces to a next level in the late 1960's: at the heart of Krueger's contribution was the notion of the artist as a "composer" of intelligent, real-time computer-mediated spaces, or "responsive environments", as he defined them [9]. Krueger "composed" environments, such as Videoplace, a computer-projection of graphic content designed in 1969. The projection was reactive to the gestures of the audience, and even anticipating some of their actions, thanks to sensors on the floor, graphic tables, and video cameras [10, 11]. Hand movements and manipulations were the modalities available. With such installations, Krueger pioneered the development of unencumbered, full-body participation in computer-created telecommunication experiences and coined the term "artificial reality" to describe it. Much later, by the 1990's, the relationship between media and architecture grew in strength as ideas became technologically and practically feasible. The application of kinetics in architecture, as the application of motion in the design of spaces, was by then re-examined under the premise that buildings' performance could be optimised if they delivered physical adaptation of forms and spaces [12]. The evolution of the field of human-computer interaction and ubiquitous computing became the driving force behind the interest in adaptive spaces and architecture [13].

More recent developments have focused on a combination of sounds and lights, such as "Audio Grove" [14]. A light and sound installation that consists of a circular wooden platform, on which vertical steel posts extend toward the ceiling. These vertical steel posts are an interface through which light and sound can be physically experienced and controlled. Visitors touching the posts evoke a soundscape, which always results in a harmonic melody whatever the combination of interactions. This is similar to the "Dune" interactive landscape, combining nature and technology [15]. Another development has seen the emergence of building as interactive systems. The Prada Transformer pavilion in Seoul is a good example. It is a pioneering structure, flipped using cranes; each side plan is designed to host a different event, hereby creating a building with four cultural identities. Whenever one shape becomes the floor surface, the other three shapes become the walls and the ceiling defining the space, as well as referencing past – or anticipating future – event [16]. The "Illumina" building in Singapore is another approach; it features an interactive facade, where visitors use mobile phone to send messages, images and graphics to be projected onto the building [13].

One last installation is worth mentioning: The "Ada Experience", it merges effectively the design of the space with interactive flooring and rich audio-visual content. The installation interacts with visitors and communicates through sound, lights and visuals [17]. Ada relies on visitors' actions such as walking, standing and jumping around to immerse them in an environment where their sensory stimulation comes from the installation and, to a lesser degree, from other visitors. Like an organism, Ada's output is designed to have a certain level of coherence, and to convey an impression of behaviour towards visitors [17].

1.2 Similar Work

In this section we review some projects that closely relate to Responsive Environments, and in doing so highlight some of their key features.

Smart Homes
Smart homes were defined as incorporating a network that links the key appliances and services and allow for their remote control, monitoring and access; as such these homes are equipped with a network to connect all appliances and systems, a control and management system to set preferences and an automation system that connects with services and contents [18].

Interactive Architecture
It about architectural projects that address changeability, adaptability and interaction issues [19]. To design such architecture, four "informative steps" are suggested: (1) Analysis (what aspects of the architecture should be interactive, and to which extent), (2) Concept generation (finding a comprehensive solution to the design problem), (3) Simulation (to check if the proposed design meets the requirements and needs of the users), and (4) Assessment (to find out the degree of compliance of the design with the requirement and needs of the user).

Interactive Public Spaces
They are about the distribution of technology into public spaces and context dependent social applications; resulting in crowd behaviour and social interaction [20]. They can be classified as performative (each user interact independently and in isolation of the others), allotted (each user share the venue of interaction with others), or responsive ambient (where all the users share the interaction and content).

Smart Environments
These are venues that rely on the acquisition of information, about the environments and their users and the processing and merging of information to improve users' experience [21]. They also are environments that adapt to their users and in doing so improve their users' experience [22]. Smart Environments were made possible via the miniaturisation of ITC and the increased functionality of everyday objects and their transformation into "smart artefacts" [23].

Intelligent Environments
Intelligent Environments were defined as comprising Sensors and Actuators (e.g. position, pressure, biometric data), Network and Middleware (e.g. wired and wireless network, sensor data processing software), Pervasive and Ubiquitous Computing (e.g. various distributed devices with small computing capabilities), Artificial Intelligence (e.g. Activity recognition, cognitive inference for decision making, Autonomy), and Human-Computer Interaction (e.g. no need for user training or specialisation) [24]. In a further development, Intelligent Environments have been defined as having reached a certain level of maturity and being ready to be implemented within real applications. Intelligent Environments are also defined as enriching the environment with technology, and relying on real-time and stored data for adaptation and interaction with the user [25]. Furthermore, intelligent Environments have the potential to proactively support their users in their daily lives [26].

2 Responsive Environment Framework

While the concept have been defined, there is a lack of a design and evaluation tool that could help design, develop, assess and classify ResEnv. A tool for a multidisciplinary design team to adopt and use in the design process leading to the successful implementation of a ResEnv. We believe this is essential, because to be responsive, a variety of channels of interaction between the users and the ResEnv need to be relied on. To be at the same time an environment, implies the emergence of a media and digital eco-system that surrounds and immerses the users. These are endeavours that clearly cannot easily be achieved without the help of a methodical approach. In this perspective, some attempts at establish a framework leading to ResEnv can be found in the literature [16, 27, 28]. Unfortunately, the proposed methods do not consider a comprehensive set of design elements and a combination of disciplines that such environments' development necessitates. ResEnv require different creative, development and implementation skills. Content, delivery platforms, modalities of interaction, methods of adaptation and finally the technology relied upon are all challenges to be addressed. Designing a ResEnv is, in this perspective, an iterative process that requires

informed design decisions from various disciplines and stakeholders' perspectives. We therefore propose a framework that offers guidelines for the design and assessment of ResEnv (see Fig. 1). This framework includes a combination of quantitative and qualitative design dimensions, each with several elements that may or may not be applicable and relevant, depending on the environment's specifications and requirements. These design dimensions relate to the architecture, technology, media, modalities, interaction, adaptation and, user experience.

One of the particularities of the proposed framework is that it includes an architecture dimension, and here architecture refers to the design of the built environment. Indeed, ResEnv are an extension of the work of Krueger [9], and Bentley et al. The latter defined such concept as a manual for designers of the built environment [29].

The framework should be used as a reference tool by designers and operators of ResEnv, helping them address each of the key elements that contribute to the environment responsiveness and deciding what level of sophistication to reach and to maintain. The framework can be used in a bottom-up fashion, starting at the architecture dimension and adding features at each of the successive dimensions, up to the user experience. In this case the design follows a system-centric approach – first defining the built environment, the technology and the content before addressing the interaction and moving on to more user related issues. Symmetrically, the framework can be used in a top-down approach, in a user-centric approach, focusing first on the user experience and the adaptation of the installation.

Another noticeable feature of the proposed framework is that its seven dimensions are correlated and interdependent. Media and modalities are an obvious case, but even architecture and experience are related (the first defines the second, and experience influences the perception of the architecture).

Looking at the framework and starting at the architecture dimension (e.g. the build environment) the properties of the environment relate to access, it is where the users can go in the environment and what are the alternative paths they can follow. It also relates to visibility and legibility, which is the awareness and the understanding users have of what is available. The environment has to possess variety: a range of possible actions and experiences for the user, as well as richness, which is the choice and the complexity of sensory experience rendered. Finally the space has to possess some personalisation, allowing users to adjust and personalise the space surrounding them. (Table 2 summarises the dimension and its specifications, inspired by [29]).

Table 2. Architecture dimension of the framework

Specifications	Measurements
Accessibility	How is the access to the different spaces granted to the users?
Availability	Is the architecture of the venue prominent within its context?
Legibility	Are the architectural spaces recognisable, from a functional and aesthetic perspective?
Variety	Is there a diversity of spaces, of layouts and styles provided?
Richness	How much architectural features and content are there in the venue?
Personalisation	Is the architecture customisable or changeable by the visitors?

After considering the different architectural features of an installation, the next dimension is technology. It is about what devices are used in the environment, how they are available to the users. Connectivity via networking between the devices, the environment and beyond needs also to be considered. Reliability (robustness, security) is also important alongside scalability (see Table 3).

Table 3. Technology dimension of the framework

Specifications	Measurements
Devices	What are devices that can be used? Are they everyday objects or specialised devices? Small (handheld), medium sized (tablet) or large (display)?
Availability	Is the technology available anytime, anywhere in the environment?
Connectivity	What connectivity is provided within the environment? Between users? Beyond the environment?
Reliability	How redundant, fail-safe and fault-tolerant is the technology? How secure and private is the environment?
Scalability	Is the technology capable of handling increased number of users, higher bandwidth, richer content and more intense usage?

The next dimension of the framework relates to the media that is delivered in the environment (see Table 4). The intrusiveness is about how significant in the user landscape is the media in question – the degree of prominence in the user's perception. The disruptiveness of the media is another feature, relating to the level of interruption it produces and how important the resulting attention it receives from the user is. Flow disruption is also to be taken into account. Other properties relate to how information and entertainment are provided. How the media is delivered and whether it is independent or embedded in an interaction context. Finally, the way media are combined in multimedia content and whether or not they are narrating a story throughout the users' visit, are also to be evaluated.

Table 4. Media dimension of the framework

Specifications	Measurements
Intrusiveness	To what degree is the delivery of content with (our without) the need for user actions?
Disruptiveness	How significantly does the media delivered changes the user's behaviour, focus of attention or experience?
Informative	What amount of knowledge is communicated? What is the information entropy of content?
Entertaining	Is the media delivered for entertainment or serious effect?
Interactive	To what degree is the media interactive?
Combinative	Is the multitude of media combined to deliver a single message?
Narrative	Is there an underlying narrative or story?

Continuing through the framework, the next dimension is modalities, the means by which the users perceive the installation and act within it (see Table 5). The modalities include our senses as well as all the actions that we can perform in particular body movements (e.g. displacements, orientations, postures), Manipulations (e.g. pushing, grabbing) or, gestures (e.g. signs, pointing). Body movements are better for navigation interaction (by just waling across the installation), Manipulations are suited for handling devices and controllers; while gestures can be relied upon for specific interactions (such as menu option selection).

Table 5. Modalities dimension of the framework

Specifications	Measurements
Address	Does the users address the installation explicitly and directly?
Readiness	How much of indication does the installation gives to the users that it is ready for interaction?
Feedback	How much are the users allowed to know about current state of the installation and what is going on?
Attention	Are the users' focuses of attention influencing the installation?
Action	Frequency and number of actions required from the user?

Closely related to the modalities, the next step is to evaluate the interaction and ensure that it facilitates and contributes to the responsiveness of the environment (see Table 6).

Table 6. Interaction dimension of the framework

Specifications	Measurements
Effectiveness	Can users comprehensively achieve intended tasks with?
Efficiency	Are resources provided allow for the completeness of a task with minimum efforts?
Affect	What subjective effect(s) does the installation has on the users?
Learnability	Can the interaction with the installation be learned and memorised? How easily can it be so?
Intuitiveness	How much of prior knowledge and experience are necessary or sufficient to use the installation?
Discoverability	How little perceptive and cognitive efforts are necessary to find out the interactive features of the installation?
Context	Does the installation render an alternate reality/context?
Usability	Is the installation free from errors, delays, failures and confusing features?
Usefulness	How purposeful is the installation? Does it address the users intents and motivations?
Comfort	Is the user comfortable and satisfied while in the installation?

ResEnv rely heavily on adaptation and personalisation (see Table 7). The next dimension of the framework adaptation is related to adjustments and changes in the service delivery to match user profile to the service provided. It is a change to fit the user (e.g. language selection). It is about adapting the service being provided to the current surrounding context (e.g. currency used in prices to match user location).

Table 7. Adaptation dimension of the framework

Specifications	Measurements
Individuals vs. group	Does the installation adapt to single users or to users as groups?
Adaptation level	What is the adaptation level of the installation: reactive, interactive, perceptive, receptive or proactive?
Personalisation	Are the installation and the content rendered anonymous, or do they rely on user identities, preferences, profiles or models?
Resources allocation	How does the installation operate when there are limited resources available? How does it resolve conflicting demands and needs

By personalisation we refer to the different levels of user information that is being addressed by the system (anonymous: or no user recognition, to model: full user recognition including preferences and interests). It is about giving experience of a service that matches details and characteristics, that are not necessarily relevant to the service provided, or do not make any difference to it (e.g. background music matching personal preferences). Finally, it is about ascribing qualities to the service such as private, individual or discretionary.

There is an overlap between levels of personalisation of an environment, and the adaptation of an environment, in the sense that both imply changes in some of its features. The contrast lies in the fact that while adaptability is a dynamic feature: the ability of an environment to change according to certain rules; personalisation is related with how much information about the user is being recognised and processed to trigger these changes, and how much these changes yield content that is specific to the user.

The final dimension of the framework is the User Experience. Interacting with an environment involves the whole body and has the potential to yield a strong experience if the environment triggers a variety of perceptions, actions and emotions with a narrative to link the variety of media and modalities, and make sense of it [7, 12]. User experience encompasses the experiential, affective, meaningful and valuable aspects of the interaction with ResEnv, but it also includes a person's perceptions of the practical aspects such as utility, ease of use and efficiency of the environment [30]. It is subjective in nature, because it is about an individual's feelings and thoughts towards the environment being considered [31, 32]. Furthermore, the involvement of the whole body makes difficult the avoidance of emotion and mood influences on the behaviour and experience: The immersive experience of a ResEnv cannot be without emotional influence(s). Experiencing emotion is dependent on the media used as well as the modalities chosen and is also influenced by the changing context and situation [33].

To support the designers of a ResEnv installation in rendering a desired user experience, inspiration can be sought from interactive art installations, where artists and designers explore further than elsewhere the rendering of feelings and meanings [15]. The desired user experience is selected for relevance and meaning in the context of the ResEnv and its prevailing theme [34]. Accomplishment, Beauty, and Wonder are good examples of experiences that might be considered (see Table 8).

Table 8. Experience dimension of the framework

Specifications	Measurements
Competence	Do the users experience dexterity and fluency?
Influence	Can the users create or modify events in the installation?
Self development	Does the installation contribute to the users skills improvements and to their better awareness of the content presented?
Enjoyment	Does the installation trigger a feeling of fulfilling entertainment?
Control	Are the users in charge of what is happening?
Autonomy	How much independence do the users have in their choice of actions?
Self esteem	Does the installation positively influence how users feel about themselves?
Engagement	How rich and intense is the installation's immersion?
Attention	Does the installation capture the users focus of attention?

The experience of the ResEnv depends on the interaction with the installation that is performed thanks to one's body, as such; our learned and cultural behaviours are essential. It makes sense to rely on social and cultural values to design the embodied interactions. The richness and complexity of the interaction in a responsive environment can be such that users need familiar guidance to help them choose what behaviour and course of action to take. A ResEnv is, after all, a space (public or private) where social and cultural values are embedded.

For each of the seven dimensions of the framework (architecture, technology, media, modalities, interaction, adaptation and experience), we have defined specifications and measurements (e.g. for architecture: accessibility, visibility, legibility, variety, richness and personalisation) that we include in our framework (see Fig. 1). This set of dimensions can be used to determine the performance and completeness of an installation in terms of responsiveness. Some of the measurements are nominal, others are ordinal and finally some are scales. Using our framework, we are able to evaluate an installation according to each of the seven elements that we have defined as contributors to its responsiveness. It is important to take in account that for each installation, some of these elements and dimensions are more relevant than others (e.g. in the case of the Prada Transformer [16], the relevance is clearly the architecture, whereas in Water Zone [35] the relevance is in the media and interaction).

While it is important to have clear measurements, we have to understand that responsiveness depends to a significant extent on the perception and experience of the user, which varies, is subjective and not always clearly defined. In this evaluation, it is therefore important to be reminded that the whole issue is about responsiveness that is

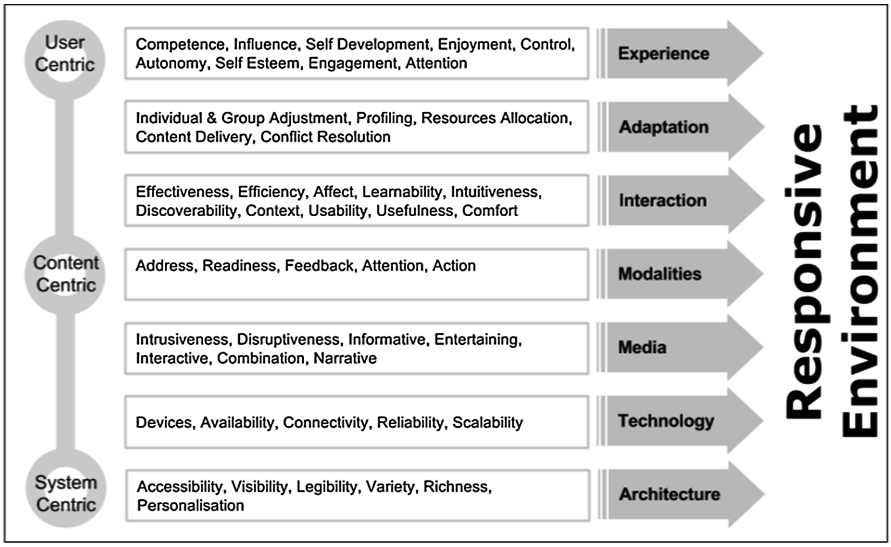

Fig. 1. Proposed responsive environments framework

perceived by the user. While our framework is useful from an analytical perspective, the evaluation process needs to be conducted with an acute awareness of the primacy of the user's perception of the installation and it's content. Furthermore, assessing ResEnv implies the consideration of addressability (when a user addresses a system, how does the system know the user is addressing it), attendance (when a user asks a system to do something, how does the user know it is attending), intention (when the user issues a command, how does the system know what it relates to), interaction (how does the user know the system understands the command) and recovery of content (how does the user recover from mistakes) [27].

2.1 Three Possible Approaches When Using the Framework

We posit that three possible approaches can be undertaken when using the proposed framework (see Table 9):

A System-Centric Approach
The use of this framework in a bottom-up prioritisation of the different dimensions would mean that the design of an installation would have a system-centric approach. In this case, the design process would begin by specifying the architecture of the environment. An example of this approach is the Prada Transformer building [16]. The design objective focuses on the architecture to deliver changing venue and context for a variety of events.

A Content-Centric Approach
In the context of responsive environments, the media are the components of the installation that are used as channels for the delivery of content, and are integrated

within the fabric of the environment. A good example of an installation focusing on media is the "Water Zone", an immersive environment that triggers feelings about, reflections on, and experimentations with sensations [35]. The visitors' displacements within the installation trigger the interaction with a projected content on the floor. Visitors are involved with the space in a playful and immersive manner; they can collectively take action in order to achieve changes in the content rendered.

A User-Centric Approach

In a third approach, this framework can be used top-down, where user experience takes priority: it is a user-centric approach. The enhancements of the environment thanks to

Table 9. Review of ResEnv with different approaches

Dimension	System centric *Prada Transformer*	Content centric *SmartEx*	User centric *Ada Experience*
Overview	A structure that can be flipped over as a mean to transform it into a different venue	An adaptive exhibition booth relying on prioritisation of visitor profiles to deliver exhibit content	Immersive experience that actively attracts user attention and give them the opportunity to make compositions of sound and light
Experience	A changing venue for a variety of events	According to their profile ranking, users can modify content	Dexterity and fluency thanks to changes in sound and colour
Adaptation	It is the physical space that change to host different events	Content displayed on screens is matching the interests of the user with higher priority	Users behaviour (individually and as a group) trigger changes in audio-visual content
Interaction	Limited to visiting the installation as a venue for events	Navigation through the exhibition booth, attention toward displays	The whole floor of the installation is interactive via pressure sensitive tiles
Modalities	Limited to attention being paid to the event happing in the venue	Users address the installation by focusing on the displays, their attention trigger a change of content	Users address the installation explicitly and directly by standing on pressure pads. Feedback is delivered in proportion to the number of different floor pads pressed
Media	Fashion events	Audio-visual Presentation on large displays	A combination of different coloured light combinations and sound. This combination does not address any narrative or story
Technology	Transformable architecture, cranes pick up the installation and rotate it	Displays, Tracking of users location and orientation	Displays, floor tiles, tracking of user location
Architecture	Highly original as it is designed to flip over and each side of the space is a floor for different events	Designed to render a corporate identity and help visitors discover exhibitor and products	Poorly explored as the installation is within an interior space with no particular architectural features. Accessibility somewhat easy, by limiting the number of access points to one
Responsive environments	Focus on a new experience of spaces and venues for fashion events	Smart exhibition booth, with a focus on delivering tailored and relevant information	Engaging, entertaining and immersive experience. Media, modalities, interaction and adaptation are used in strong clustering and combinations

media and technology are there to facilitate the desired experience, and not solely to be experienced per se. The installation becomes a result and consequence of the designed user experience, and its materialisation exists to give form to and to deliver this experience. Here a good example to illustrate this approach is the "Ada Experience", which encourages users to develop interaction skills, by allowing them to make compositions of sound and light [17]. This is made possible because the behaviour of the users controls what is happening in the installation.

3 Conclusion – A Direction for Responsive Environments

Our agenda for future research is to apply this framework in the design, development, assessment and classification of installations that focus on personalisation and adaptation. We see the design of a responsive environment and of its components, as a combination of installation, media, modalities and content that can provide users with experiences that are rendered in a new fashion, opening up opportunities for interaction and adaptation. We have already had a glimpse of such an environment thanks to our SmartEx installation [36]. Through our experiments we have demonstrated that profiled non-adaptive presentations are better suited, compared to a generic presentation for an effective and efficient information display strategy. We have also demonstrated that the improvement is significant and measurable. We have also indicated that the use of profiled and adaptive presentations is promising as a whole and across profiles.

In the perspective of architecture and space, it is also clear that content cannot be a mere conversion of traditional formats towards digital and space-integrated formats. One of the key features of ResEnv is that architectural elements are turned into media. Designers creating ResEnv need to take into account the purposes addressed, and choose what media or technologies can deliver these efficiently, effectively and in a user-friendly manner.

When adaptive components, services and content are focused on the user experience, the environment becomes responsive. The responsiveness can be in the form of the physical structure of the space (e.g. movable panels and partition walls). The changes can also be related to the ambient features of the space such as lighting, acoustics and temperature. Finally, the changes can relate to the content presented in the space, such as media, information, and interactivity available. Clearly there are many avenues to adaptation and ultimately responsiveness. We believe in the need to build system demonstrators to investigate various content, design, technology and interaction solutions. As seen in the reviewed examples (and beyond), ResEnv are emerging from architecture, which is moving from static to dynamic forms, through the use of technology. In some cases, the technologies are an obvious choice and are clearly visible to the visitors (e.g. involving tangible interfaces), while in others it is rather innovative and invisible (e.g. involving sensors). It is interesting to compare, in terms of meaningful experience, how these technologies are applied. While in first case, users tend to feel the installation is mechanically responding to their actions, in the second case users feel the installation is naturally responding to their behaviour.

Most developers of ResEnv have been focusing on creating spaces, environments, objects, application that prioritised usability, functionality, or positive user experience.

The design process was always associated with the installation, technology and content involved, while the human contribution to the installation, shall it be from the end user or from the installation staff was mainly ignored. We advocate that the user and the staff of the installation can, and should, have a significant contribution to it. If, on the one hand, the design of spaces can strongly influence the user experience, on the other hand it is undeniable that the behaviour and "choreography" followed by the environment "staff" and user can be a significant contributing element to the environment. A user experience, in this context, is not only facilitated by the space, the installation and its content, but also by the staff and their behaviour and "rule of engagement". The design of staff services and behaviour can be seen as the design of choreography: a performance. This choreography or performance becomes the "human contribution" that triggers the user experience, which long before being triggered by technology or design, were triggered by human contact, within social behaviour, as design history has shown us with the pioneering work of Charles Mackintosh: his architecture proposals included the design of the house, the furniture, the cutlery, the dishes, the costumes and even how staff should behave. It seems to be an interesting future direction: to integrate into the spaces the design of such "performed actions".

We are proposing a framework to provide guidance for the design, development, assessment and classification of ResEnv, hopefully allowing for a critical, informed and objective analysis.

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