# Exposing Collections through Interaction Ecologies: A Prototype for Architectural Ephemera

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This study introduces a model for the observation and design of digital collections exhibitions rooted on three concepts: interaction ecologies, exposing collections, and architectural ephemera. The study examines how to go beyond the "one user, one device" approach in GLAMs, what it means to expose a collection, and what it means to consider architectural elements as ephemera. We define interaction ecologies as the approach to a context in which individuals of different species (devices and humans included) entertain rich and floating relationships appropriate to the roles, activities, and postures they assume. This perspective offers novel possibilities on the exhibition of digital collections. In addition, we discuss the concepts of exposing a collection and the translation of architectural elements to transient artifacts to preserve memory. This discussion allows a series of qualities to emerge that together constitute a model for the observation of collection exhibitions. The study includes the presentation of the exhibition "Ankara Balcony Balustrades 1950–75," which, by focusing on these aspects, acts as a prototype of the model and helps in verifying the application and its results.

## 1 INTRODUCTION

This study explores how a collection of architectural ephemera can be exposed through interaction ecologies. The article is organized in four parts: a background that presents the theoretical basis, the development of the prototype, a model that presents the design decision taken to apply these theories, and the conclusion with final remarks and evaluation.

In the Background, we aim to clarify our position by discussing the three core concepts: interaction ecologies, exposing a collection, and architectural elements as ephemera. The model brings these three concepts together and connects them as a prototype presented within an exhibition titled "Ankara Balcony Balustrades 1950–75."

This exhibition has three components: a video-interview, a cross-device installation that connects a wall display with visitors' mobile phones, and a series of 360° photographs mapped on the floor through QR codes. This space of interface supports the creation of what we define interaction ecologies, that which embraces multiple devices and people together. To start discussing the term interaction ecologies, we can provide a few examples of the discussion on the role of interaction techniques in cultural heritage through three cases: PEACH [31], meSch [25], and SPICE [9]. The first two projects and related research focus in particular on personalization and customization and the role of curators in establishing a narration for interactive exhibitions; the third focuses on citizen curation and the role of the audience in contributing to the curatorial process. While we share similar intent in questioning the manifestation of the authority of cultural institutions and the appreciation for the opportunities offered by the involvement of the audience, in this article, we aim to focus on the possibility enabled by the interaction techniques of establishing ecologies, an environment of information exchange among people and devices.

## 2 BACKGROUND

### 2.1 Interaction Ecologies

The adoption of digital tools to present collections in the exhibition spaces of **GLAM (Galleries, Library, Archives, and Museums)** is common practice today. Conversely, the approach applied to this digital experience is mostly oriented to the individual [32]. Researchers in the interaction design field have for many years advocated for the adoption of a model that goes beyond the "one user, one device" approach. These approaches, already established from a theoretical standpoint, can benefit from novel techniques and can be explored further in the spaces of GLAM.

So far, the interaction design community assumed different definitions for the shared intent "to understand, create, and deliver experiences that transcend the individual device" [7]. Brudy et al. choose cross-device computing to satisfy their definition. In their paper, they separate the denomination in two parts containing on one side a device-related term ([cross-device, multi-device, distributed], [cross-surface, multi-surface, trans-surface], [cross-display, multi-display], [multi-monitor/screen, multi-slate/tablet], [dual-display/monitor], [multi-mobile]) and on the other what they describe as focus ([interaction, collaboration], (user)interfaces], [applications, systems], [platform, middleware], [environments, ecologies], [computing]). This classification poses ecologies and interaction as focus descriptors of an approach that is always centered on the technological aspect (device, surface, display, screen . . .).

In our perspective, we adopt the term interaction ecologies tracing the evolution of thoughts from Bateson [3] to Gibson [14], to Krippendorff [18] and Bonsiepe [5], the Danish-Swedish groups of Enquist, Tollmar, Corry [35], and more recently Lyle, Korsgaard, and Bødker [20]. This imaginary trajectory, as only few of these authors directly build or refer to each other's, starts from Bateson's extension of the concept of ecology beyond the strict environmental concern. In his theory, he borrows from environmental ecology the characteristics of relationship and influence, flexibility and distribution, and carries them towards an ecology of ideas. Bateson establishes a list of virulent ideas that afflicts industrial society and poses individualism as one of its core values [3]. Bateson's theoretical move allowed later thinkers to operate similarly on ecological approaches in different fields. Krippendorff extends the discourse of ecology towards communities in declaring that "in an ecology of biological organisms, each species lives in its own world which includes indigenous responses to those species they come in contact with. Overall conceptions of an ecology are beyond the worlds of any one of its participating species. Ecologists who tend to model a particular ecosystem are not exempt from this generalization. I dare say that this applies to discourse communities as well" [19].

These theories extend the meaning of ecologies and the species involved, towards ideas and artifacts other than humans and other critters. Extending this evolution of ecological thought in regards to the space of interface, it seems logical to consider the coexistence of multiple devices in an environment, as it is intended, for

example, in **ubiquitous computing (UbiComp)** or cross-device approaches [7]. Furthermore, as highlighted by Krippendorff, the study of an ecology is incomplete if all the species in the environment are not considered, and consequently, in interaction ecologies, accent should be put on people and their role. "Although rarely acknowledged by ecologists, humans necessarily are part of any ecosystem for two reasons. First, even small ecologies are usually constructed with the intent to intervene. [. . .] Second, large ecosystems and especially global ones, to be fair, can hardly exclude humans as a species that lives with other species, feeds on many, encourages some, or seeks to extinguish those considered harmful to them" [18]. Within this frame, interaction ecologies consist of a number of people and devices within a context, and the variable role and relationship entertained among themselves. We characterize roles and relationships as variables, as they can change in time according to the current activities and reciprocal influences. According to Enquist et al., these ecologies can be seen as "a functional set of artifacts, people and the surrounding environment, in combination with the rich interaction between people and devices" [35].

In comparison to our definition of interaction ecologies, the term cross-device appears too restrictive due to the excessive attention to the role of devices. Interaction ecologies, in our proposal, embeds an approach to cross-device computing. Devices that do not interfere and influence people, devices that do not establish relationships with other devices, and devices that act as individuals in isolation are devices in direct contrast with the definition of ecologies. While the extensive review in Brudy et al. [7] collects and clarifies many positions in the field, we prefer the term interaction ecologies, as its focus is on people, devices, and contexts. For the same reasons, interaction ecologies is chosen over artifacts or device ecology, because in both cases the accent is on the technological more than the human or at least relational aspects. The term information ecology seems to be adopted in literature with an even broader view than interaction ecologies with "understanding being tied to some big picture of a phenomena, going beyond technological artifacts or activities to also include the physical space and cultural practices of a particular context" [20]. This extension might exceed the need of the study and risk a loss of focus. Furthermore, the word interaction gives roots to the study in the field of interaction design.

We position interaction ecologies as an approach in which individuals of different species (devices and humans included) entertain rich and floating relationships appropriate to the roles, activities, and postures they assume. During the execution of an action, a person can be an actor or a spectator, participating through a device or in direct relation with other humans, and so devices can be used by an actor, be observed by a spectator, demand attention by a bystander, disappear lying dormant in idle mode or communicating with other devices while influencing the context, which in turn, is altered by those same actors as humans and devices. Interaction ecologies are complex to investigate and as such can be partially studied, explored, and exploited at varying depths according to the aim. "[E]cologies of artifacts, even of only moderate complexity, escape any one individual's understanding. To cope with this complexity, we may have to be satisfied with partial theories of how artifacts interact" [18].

This purposefulness of investigation is reflected to a purposefulness of the ecology as highlighted by Rogers: "Instead of embedding pervasive computing everywhere in the environment, it considers how UbiComp technologies can be created as ensembles or ecologies of resources, which can be mobile and/or fixed, to serve specific purposes and be situated in particular places" [27]. In the context of GLAMs, adopting interaction ecologies means directing towards an alternative solution to the individualization of the experience of a visit and enrich the socialization among people through and with devices. "The majority of museum visitors attend in social groups, but prior studies of mobile device use in museums reveal that a major complaint associated with the use of mobiles is a feeling of isolation, so if we make use of the devices, then we must also take care to preserve social interactions within groups" [17]. The study of interaction ecologies aims at challenging this isolation and orienting researchers and designers to evaluate their decisions and observations, acknowledging the co-presence of multiple people and multiple devices in a context and going beyond the lenses of technology, beyond the one-to-one interactions and beyond a stable assumptions of roles.

## 2.2 Exposing a Collection

Exposing a collection means offering an explorative possibility to the audience and bringing them closer to the researchers, instead of presenting a curated and somewhat resolved exhibition. Exposing is here loosely connected to the threefold definition of Mieke Bal [2]. We intend exposing as the act of showing the content of a collection by allowing the participant to interact and explore the data with minimal interpretation. The act of saying "Look! This is what we brought together" against the view, criticized by Bal, as "Look! That's how it is." We do not claim neutrality or the absence of an interpretative act (we will discuss in detail our choices regarding the case study) but prefer holding back the interpretative reasoning and the resulting deduction to give space to peoples' own interpretation. This approach is similar to the explorative graphics in Bogost et al.: They "show data that is meant to be synthesized by the user independently of the creator's expectations" [4].

The tradition of hierarchical communication in which the institution has to declare and direct is substituted in this approach by the richness of the dialogue and participation.

While Bal claims that "In expositions a 'first person,' the exposer, tells a 'second person,' the visitor, about a 'third person,' [2] the object on display, who does not participate in the conversation." Our aim is to take a risk and expose a naked, raw, even incomplete view of the collection in the hope that viewers will switch their role from *second person* to *first* and establish a direct dialogue with the *third person.* The risk is obviously referred to the possibility that "without author synthesis the data remain raw and undigestible" [4] but we argue that is a matter of balance. With the adoption of interaction ecologies, people can assume the role of viewers, participants, exposer, visitors, and performers and float among these roles by using devices and dialogue with the environment in search of their interpretation of the collection.

This approach can be juxtaposed to the concept of *citizen curation* in which the audience is brought to participate in the curation process through a *curatorial inquiry learning cycle* [34]. In this case the intervention of the audience is limited to a parallel storytelling via social media without direct intervention to the exhibition setting. The possibility of editing content annotation was shared exclusively among the project team. For this reason, we cannot fully define our prototype as an application of citizen curation, and for this reason, we define exposing as a more adequate term that highlights how the collection is presented more than how it is possible to intervene on it.

## 2.3 Grouper

The interface aims to take the place of the *first person* and expose itself showing its limits and its potentialities to the actor. The person/actor is enabled to inspect the collection closely and discover which paths can be followed, which aspects can be explored, which data are available or not. A research project named Grouper [28] was established with the aim of supporting the study of a collection with the researcher needs in mind. The research entails a computational interface that applies a theoretical foundation developed with an Object-Oriented Ontology lens and synthesized in a series of aesthetic qualities. We will briefly introduce the interface to then focus on some of these aesthetic qualities.

Grouper is concretized in a computational interface for the study of collections aimed at easing the work of the researcher. In particular, it aims to facilitate the construction of findings by providing early visualizations and tools for the independent researcher who wants to have a better understanding of their collections. Grouper is a long-term project started formally in 2016 and developed within the study of several collections in the past years. These are: the Turkish cigarette packages (1900s–2010), the brands of the Italian Central Archives of the State (1948–1970), the Turkish and Middle Asian musical instruments (2019), the Turkish fanzines (1990–2018), KulturPlant (2019), and last, Ankara Balcony Balustrades (1950–75). The possibilities and features of the interface were improved through these iterations and the set of views was extended relatively and currently includes the following: index card, data table, catalogue, timeline, grouping, composition, geographical, radial tree, timeline with groups, and summary (Figure 1). Grouper offers the possibility to visualize multiple views
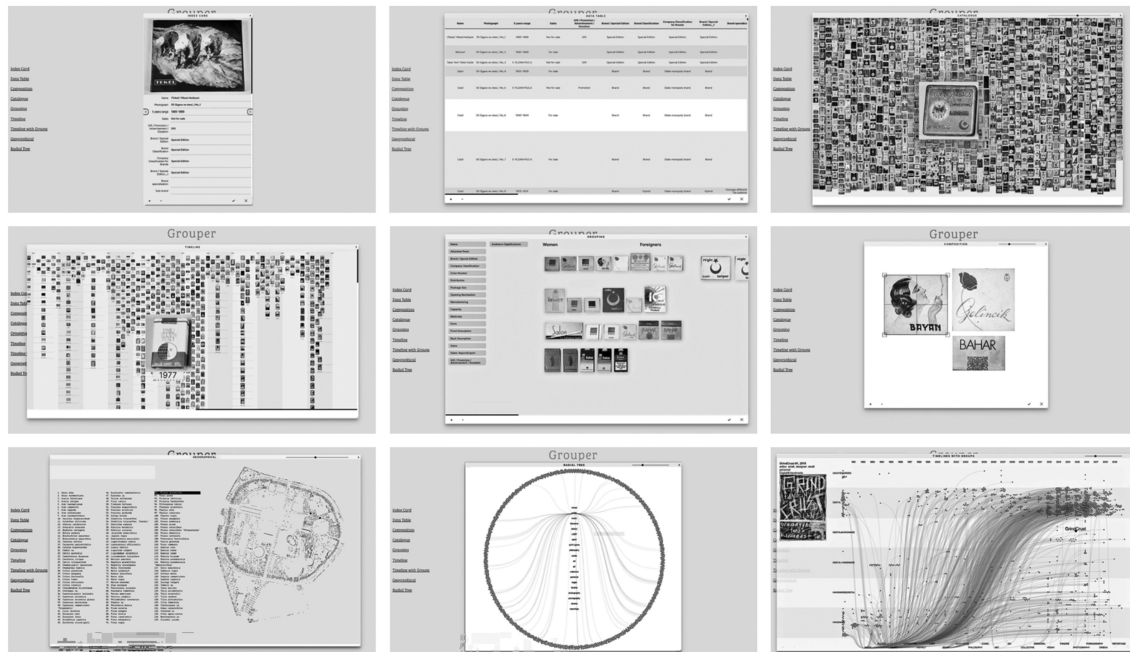
Fig. 1. Nine views of Grouper visualizing different collections. From top left: index card, data table, catalogue, timeline, grouping, composition, geographical, radial tree, timeline with groups.

side-by-side and organize them freely on the work area. This open work area allows the researcher to operate on the collection while having direct control over details and overviews. A level of optimization guaranteed with the adoption of a simple HTML5+javascript+JSON architecture permits the operation to stay smooth with a relatively large number of items. During the creation of the geographical map in geojson.io, the researchers in charge of the operation find themselves obliged to split the map in areas to keep the platform operative. Conversely, upon transfer on Grouper it was possible to work on the entire collection and map without any slowdown. Beyond the merely technical aspects, the selection of features and design choices were guided by a rich theoretical background and a set of principles that we defined as a set of aesthetic qualities.

In Savasta and Kocabıyık [28], the following aesthetic qualities are identified: translucency, surfacing middleware, witnessing, exploratory, dynamism, dialogic, avowing uncertainty, biological view, and cure. Among these aesthetic qualities, we will discuss briefly translucency, witnessing, exploratory, and cure, as they directly support our current aim of exposing a collection.

The presence of the interface, its manifestation through the variety of devices, enacts its *translucency* as a balance between transparency and opacity, between disappearing by enabling the actor to interact effortlessly, and by demanding attention and claiming its existence in an act of self-criticism. The interface shows its power to the actor and in return it makes its presence and authority criticizable. It is here that the ecological quality of affordance shapes itself. The affordances of an interface are those potentialities that an actor can exploit through action. An over-simplification of the interface can send it out of control; an over-cramped interface can also lead to cognitive overload and loss of control. Balancing between transparency and opacity is a matter of usability but especially a communicative expression of the actuality of the interface and its role in interaction.

In Grouper, *witnessing* is a way of providing privileged access to researchers that can move between visualized, interpreted, presented interfaces, and raw exposition of the data. The aspects of analysis, evaluation, discussion, and iteration over a collection constitute the *exploratory* aesthetics for which the process of discovery allows for

a varied range of conclusions. *Cure* is intended in Grouper as an approach that is curatorial but also, in a literal sense, a way of taking care, in metaphorical terms, a way of "medicating" the collection. This process includes acknowledging the fallacies in the dataset and providing continuous treatment by integrating and improving its content as well as repairing eventual mistakes and imprecisions. Curating with Grouper is a way of taking care, managing, interpreting, and maintaining the collection to enhance its aspects and extend its discoverability; a process of reversed entropy [10]. The process of curation is a process of empowerment that allows the creation of new affect, new activities, new potentialities.

Grouper provides a theoretical background as well as a computational interface from which exposing a collection becomes an expected consequence. In other terms, Grouper assumes the role of *cognitive support*, *feedback loop,* and *externalization as conversation* [6]. For this study, Grouper was first adopted to create and curate the collection and in the final phase, enriched with new features, focused on the exhibition aspect, the collection's exposition. In Grouper the original focus is the researcher but in this study the focus shifted to the audience and the interaction ecologies built around them. The adoption of Grouper was limited and while only some features were used within this study other new ones were developed specifically to answer the needs at hand. Specific to this study is the creation of a controller interface running on mobile phones for interacting with the collection and a large projection display management, which will be discussed in the Development section.

## 2.4   Architectural Elements as Ephemera

Ephemera are "item[s] usually printed on a single sheet of paper, [. . .] created to serve a certain purpose, and to be discarded afterwards" [1], they are transient, mobile, and easily collectible. In opposition, architectural artifacts are generally regarded as lasting, rooted, and voluminous objects. Consequently, to speak of architectural elements as ephemera, we are bound to make a speculative leap.

The concept of ephemera has been adopted in connection to architecture to describe urban phenomena that shape our cities. In particular, it was adopted in regards to temporary events like festivals [30] or sensorial aspects of the city like its smell [21]. In both cases, the aspects considered as temporal or intangible go beyond the physical dimension. A necessary operation for collecting architectural elements is the one of translation from the physical object to one or more of its representations in print as well as on digital support. By translating architectural elements into ephemera, we aim to generate traces and remains to overcome their "impossibility" of being preserved and collected and consider how they refract history, how they can be cared about, and how they can be connected to people [22]. While McMullan et al. do not elaborate on the meaning of refraction, we can speculate by keeping the light related metaphor and relate it to the aesthetic property of translucency that we defined for Grouper elsewhere [28]. Refraction means "the action of distorting an image by viewing through a medium" [23] and the deflection of light rays due to the change of medium passed through. In these terms, refraction becomes a way of reading history through ephemera, which will change according to the contribution the ephemera makes. Their role is "[i]mportant in delineating and describing certain areas of popular thought and culture that may not be captured in other media and formats; to this extent, ephemera should have a place in cultural repositories" [11]. To create a place for, to care and to cure architectural elements ephemera, it is necessary to establish a collection starting from the creation of ephemera themselves. The choice of which representation is more appropriate to capture the presence of architectural elements, which, as we will see in our case study, might be indeed transient and rapidly change and disappear as if they were proper ephemera. The relation with people in the case of architecture is a core matter including function, scale, and perception. If this figurative process of ephemerization is indeed a process of digitization, "how to preserve the relationship established between people and architecture?" becomes a leading question to ask. Architectural elements ephemera, as a consequence of this process, can constitute a collection that can occupy limited space (with all the benefits of flexibility and capacity of being organized in digital spaces), can be mobile and portable, as well as transient or even better dynamic in its possibility to change in time and be cared for.

## 3 DEVELOPMENT

### 3.1 Preparation

This study for "Ankara Balcony Balustrades 1950–75" started with a set of digital photographs of the balcony balustrades from Ankara, capital of Turkey, dating from around 1960–70. The set included around 4,000 photographs and were accompanied by printed maps containing sketches of the paths made during the survey and the position of the balconies. This survey, just a few years old, constituted the base on which the collection was built. We started by establishing a few representation methods to extend the collection and constitute the corpus of ephemera.

The first technique was to capture the balustrades and the buildings through 360° photography. The aim of these 360° photos was to provide the possibility to the audience to "transfer themselves" to the location and context of the building. In a similar way to Google's Street View, people can explore the surrounding of the building, helping them understand the context and maintain a perceptive relation of scale with them. Furthermore, this representation aimed to give a feeling of familiarity by recreating the experience of observation from a habitual point of view. In this case, we were faced with two issues: the balustrade being absent; either due to a newer replacement or to the reconstruction of the entire building, or the balustrade being not visible, usually due to vegetation or, more rarely, the absence of a vantage point for photography.

The second technique chosen to represent the balustrade was illustration. The process included the creation of a representative sample by choosing a series of photographs that could represent the overall appearance of the collection. Then the photos were observed and drawn with a vector software in the attempt of preserving the salient aspect while creating a highly abstracted representation. In this case, a series of criteria was established to create a set of illustrations that preserved their unique traits while being uniform and comparable overall. These criteria included: all balconies are to be represented with a front view, with the most common balustrades present in the same building to be selected. All balconies are to be represented with a constant height and one of two alternative widths, the balcony flooring having a single representation style independently from their real form (thus focusing the attention on the balustrades instead of the balcony and to provide a sense of uniformity). Finally, three-dimensional balustrades having a significant part developing on the z axis are treated by rotating a portion of the balcony to the sides of the balcony (the balustrades sides are included in the representation). This abstraction allowed the audiences and researchers to refer to several balustrades at the same time and both generalize and specify their belonging to a group or typology. Next to the addition of these representation techniques, other steps were taken to digitalize the collection. For example, the original photographs were edited to improve the visibility of the balustrades and clean from advertisements and other intrusive features.

The construction of the database started within GeoJson.io (http://geojson.io/), "a platform that supports the open source format **GeoJSON (Geographic JavaScript Object Notation)**" [26]. The balustrades were located in the map and accompanied by a basic set of data (address, apartment name). This tool allowed multiple researchers to work independently on different areas, and the fragmentation in areas helped to keep the dataset smaller so as not to incur excessive loading times while working within this platform. An important step was the naming convention that was established to map the photographs to their location. The map was divided in neighborhoods, and the apartments were numbered sequentially within the neighborhood. The convention was then established as nnnn000d.jpg, where the four initials represent the name of the neighbourhood, the three digit the sequential number, and a final letter as a descriptor of the type of photos (either a detail or a global view).

### 3.2 Consolidation within Grouper

At this point, the data was transferred to Grouper where the different databases were merged into one. Within Grouper, we consolidated the collection by bringing together the geolocation data from GeoJSON.io, the retouched photographs, the illustrations, and the 360° photographs. When all these were linked in the database, the platform was made available online to the research group to improve the information relative to the balustrades
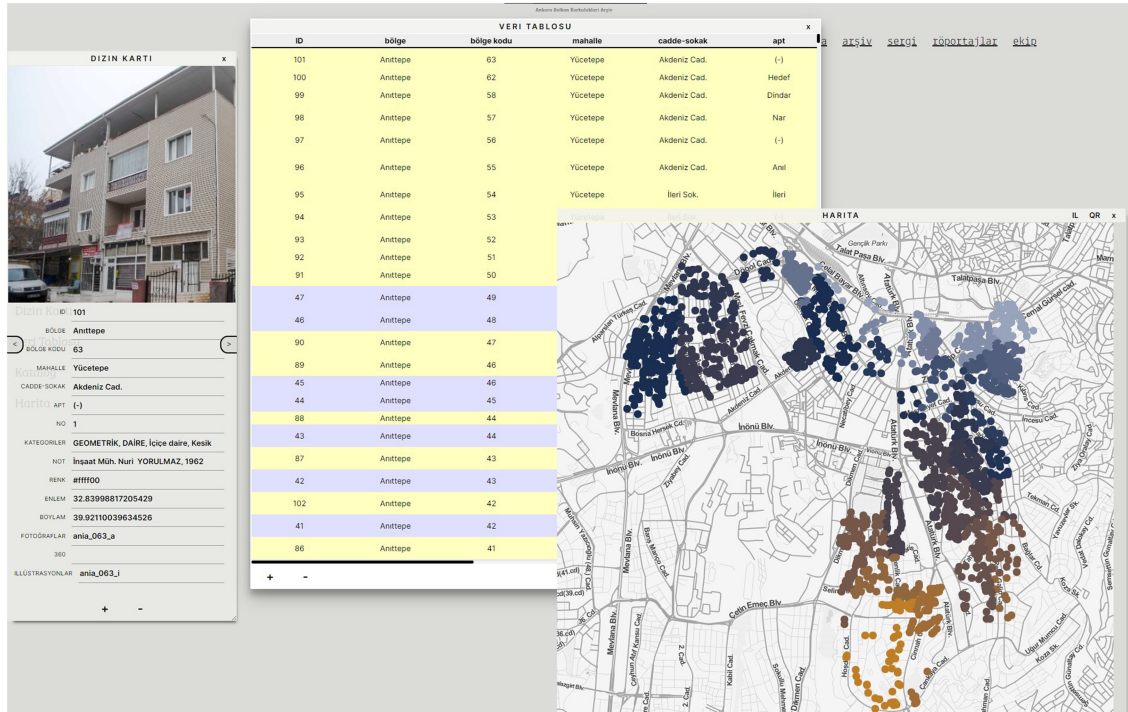
Fig. 2. Grouper interface with three views presenting the Ankara Balcony Balustrades collection. From the left: index card, data table, and map. In both data table and index card, the researcher can edit directly the data by double clicking on the field to update as well as adding new data field to the schema or adding/removing an entry.

and to allow several researchers to work on the same database simultaneously. The dataset was edited and extended with a series of metadata including a unique ID, the unofficial neighborhood name "identified by the researchers as the way it is commonly referred to by the citizens," the official district name, the full address, the name of the apartment, as well as a formal description of the balustrade and references to the visual media. Furthermore, where available, we included the name of architects, designers, and craftsmen involved in the balustrades production, date of construction, and the actual existence of the building. A repository containing the relative JSON files is available at Zenodo [30].

Grouper offered in this case the possibility to alternate and simultaneously work on the geographical map, a data table view, an index card view (Figure 2), and a summary that showed statistics about the data completeness and variabilities (e.g., how many different categories, how many different regions . . .). This view was also used to do an error check to control whether some data was incorrectly typed or different versions of the same word were input by the research team (e.g., visual categories used as "square" or "squared"). The editing of the database continued even during the time of exhibition and after in the online platform. Finally, a series of interviews conducted with researchers and practitioners involved in the study and production of balustrades in Ankara were realized to contextualize the content of the collection. The final collection contains examples of balustrades from a wider period than estimated initially, including balconies built between 1950 and 1975 with 1,813 unique entries divided in 14 main regions, 41 official districts, and 309 streets.

## 3.3 Exhibition Setup

This collection was then analyzed to prepare the exhibition plan, the "how" these information are translated into interaction ecologies and exposed as a collection to the public. The exhibition is shaped into three parts.

Fig. 3. Screenshot from the interview video. The layout presented resembles an interface to orientate the viewers within and inform about the video.

The first part is a simple video interview (Figure 3) report that collects salient portions of the interviews in a one-hour-long video. The interface of this video was planned to present a series of topics always visible to guide the viewer regarding the subjects explored.

The second part is a 360° walk (Figure 4). This walk consist of a series of QR code markers representing a selection of the balcony balustrades distributed geographically on a highly abstracted map of Ankara city center drawn on the floor. This map allows people to navigate through the city by physically walking between the districts and reach balustrades through their mobile phones by scanning the corresponding QR codes. The interface visible on mobile phones presents the viewers with 360° photographs that can be explored with the movement of the mobile phone as if to hold a magnifying lens. The photographs are edited to provide emphasis to the interested apartment and its balustrades by highlight [15]. The apartment to emphasize is kept to its original color while the rest of the scene is rendered in duotone. A button opens a card providing information pulled from the database related to the apartment.

The third part (mobile+wall display in Figure 5) constitutes an example of interaction ecologies per se, as it is structured around the interaction of at least one person and two devices but sees its best application with even larger numbers of interactors. A large projection display influences and stands above the overall exhibition area showing a large geographical map of Ankara powered by OpenStreetMap [24] and adopting the map tiles Toner by Stamen. A series of markers symbolizes the entirety of the balustrade collection. Through an informative board and by scanning a QR code, viewers can become actors and take control of the large display through their devices. A custom interface on mobile guides them through the database and allows the exploration of the collection, exposing the different aspects of it. Their device is now part of the exhibition, following a **BYOD (Bring Your Own Device)** logic [8], and it presents an interface constituted of a series of control diagrams while the content is kept on the large projection display for the public to see. The exploration driven by the small display of the mobile phone are immediately reflected within the space of the large projection display.

Fig. 4.  360° walk.Top left: the exhibition space, an abstract map on Ankara the floor, and the QR code while people navigate through it. Top right: a visitor accessing a 360° photo through a QR code. Bottom: the 360° photograph that the audience can explore through their mobile phones edited to highlight a specific apartment.

The viewer is rapidly brought to be an actor and consequently a performer in front of other visitors (Figure 6). The size of the display and its position in the space promote a physical engagement in what can be seen as a timid gestural dance. The large projection display smoothly oscillates through views contributing to this dance. Beyond the map, the display presents a catalogue of all photographs and illustrations, as well as individual cards showing the overall metadata regarding the balconies. This case of interaction ecologies is constituted by the visible participation of people, mobile devices, the large display projection, as well as the server that provides the devices with their content.

## 3.4   Technical Note

The architecture of the the mobile+wall display (illustrated in Figure 7) is built around a server developed on WebSocket technology and controls the communications between the large display projector and the mobile devices of the visitors who access it through a local WiFi hotspot. The clients, one running on the mobile
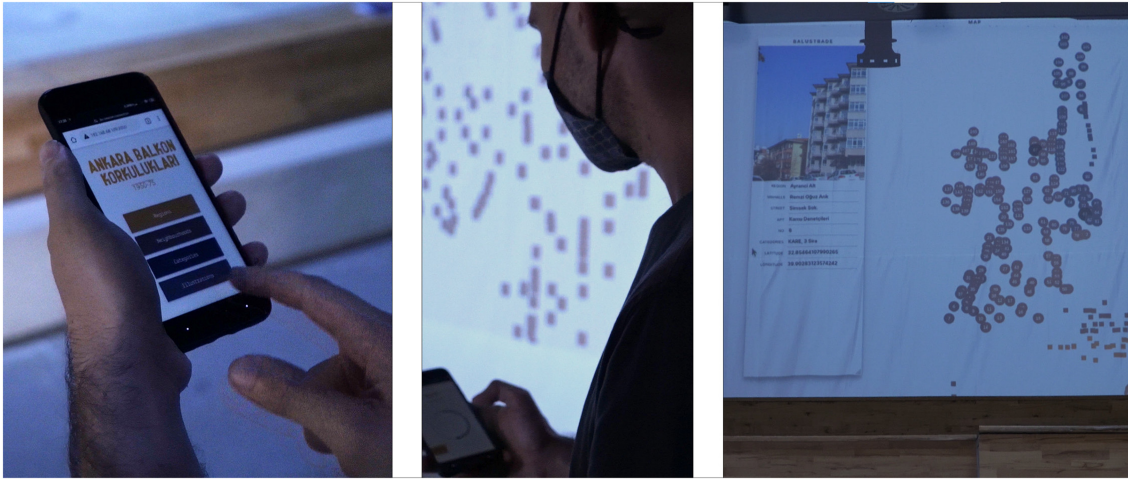
Fig. 5.  Mobile and wall display. Left: a detail of the welcome screen on a visitor mobile device. Center: the relationship between the person interacting through a phone and the wall display. Right: an overview of the wall display projection.
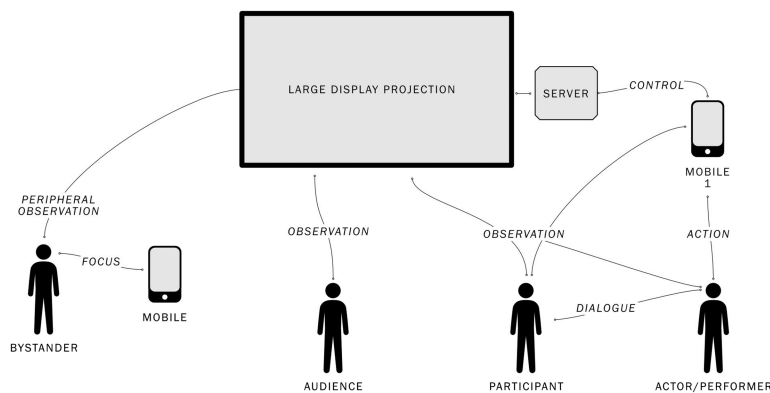


Fig. 6.  Mobile and wall display interaction ecologies diagram. The interaction ecologies diagram illustrates the relationship among people and devices and their roles at the time.

phones of the audience, the other running on the server feeding the large projection, are both developed as web apps written in HTML5+Javascript. This simple architecture facilitates seamless communication and allows for a large number of simultaneous connections. In this specific prototype, only four simultaneous connections were enabled to allow each actor to manage a large enough portion of the display for their own navigation. A higher number of simultaneous connections, although technically possible, would have required a different design and produce a different interaction environment. A reduced version of the app for the web is available at www.ankarabalkonkorkuluklari.org.

## 4  FRAMING A MODEL

In the previous paragraphs, we established a background framework in which we position the prototype introduced in the second part. Within this framework, we established a series of qualities that stem from "interaction ecologies," "exposing a collection," and "architectural ephemera." In addition, a set of qualities
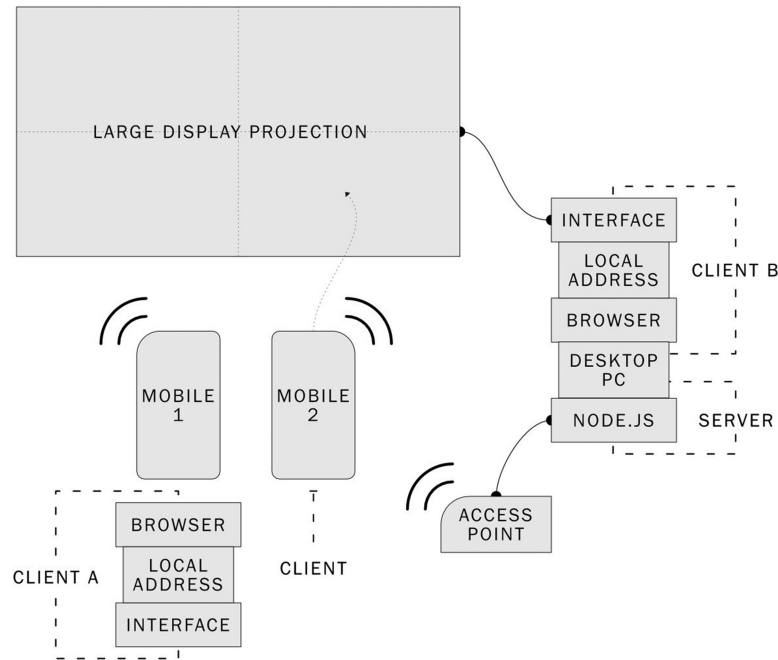
Fig. 7. Mobile and wall display technical diagram. Technical diagram of the wall display and mobile phones structure for the exhibition.

derived from a previous study [28] converge and contribute in shaping this set. We deduce from the background: roles, relationship, and flexibility in interaction ecologies; raw data and exploration in exposing collections; refraction and transient in architectural ephemera. These seven qualities contribute differently in shaping the exhibition presented as a prototype. Through the diagram (Figure 8), it is possible to establish this connections visually as well as observe how Grouper influences this study.

## 4.1 Roles and Relationships

The first design principles derived from interaction ecologies is the creation of variable roles. In our prototype, we applied such an approach in the 360° walk and the mobile+wall display. Each of these two installations surround people within an interactive circle. The 360° walk creates a context of walking and stumbling around people observing and being observed, acting and thinking, aiming at that fluctuation of roles mentioned above. People change their attitude and posture towards the others and toward the devices they use. When activated, their mobile phones become a lens in their hand, diverting their attention somewhere else in Ankara and blurring the context of the exhibition in the background. When the exploration is completed, the visitor is back in the middle of others trying similar attention transfer or conversely observing the others' actions. As observed during the exhibition, people encounter each other in the process and establish a conversation over the different balustrades observed and making comparisons among them. The mobile+wall display is even more transformative in terms of roles. The projection passes from a state of passive background influencing the ambient to become the display center of attention when activated. People roles figuratively oscillates but in this case observers are further involved in the content of the research of the actor who controls the display. According to our observations, people tried to suggest what to look for or gain control of the display over the other participant in a sort of mild competition. On the device side, the server and the clients managed a dialogue over WiFi influencing each other. The server always maintaining the actual state of the system and providing related data to the two clients.
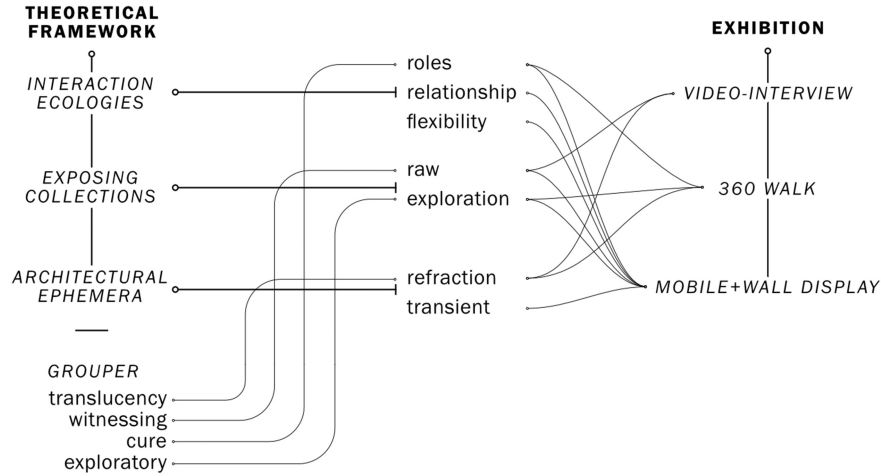
Fig. 8. Theoretical framework and prototype model. A model for exposing collections through interaction ecologies.

The first client active on a mobile device communicates and controls the second client that, installed on the same machine as the server, communicate directly to the large display. The posture and proximity adopted by the audience joining the interaction followed their role with, in our observation, the person who controls the display getting closer to the projection wall and other people willing to interact getting closer to the actor as if to steal from them the controller while talking to them and creating a first verbal form of negotiation before intervening on the display. This relation and positioning, while not necessary for the work of the installation nor functional to the access of information, as the projection allowed reading from a much wider area, became the norm among audience when multiple people were simultaneously interacting with the display. The action that commonly is limited to one person in this case becomes a social act.

## 4.2 Raw and Exploration

The overall exhibition was established around raw visualization of the collection showing more the process of research than any final result. The video interviews were in fact part of the research and not aimed at a different audience and then revealed and only minimally edited to allow their exploration in the limited time. The interface of the video interviews was designed to present itself as an exploration space revealing all the interviewee names and subjects discussed at any time, showing the categorization of these subjects. These data were shown within a frame, giving the audience the familiar feeling of an online video platform. This treatment offers a feeling of control to the audience and captured the attention of visitors who wanted "to hear the part of this professor" or "listen about that other subject." The mobile+wall display was directly showing the database scheme presenting a "behind the curtain" view in which people could navigate in free exploration. Similarly, the balustrades on the map were uncommented beyond the formal categorization useful at grouping them to show their repetition around the city. People were given the opportunity to create new links and establish their own tours between the mapped balconies following their own interest and personal choices. The different views offered within the mobile app similarly showed a multitude of reading possibilities of the same content, giving the opportunity and the space for interpretation by the audience.

## 4.3 Refraction and Transient

The balcony balustrades were represented through different techniques. Illustration, photography, and 360° photography were juxtaposed to provide an original yet familiar view. Not the view through a transparent glass

revealing the truth, but a refraction revealing partials, perspectives, possibilities, questions instead of answers. While in more traditional exhibition or GLAM spaces the artifact is shown in itself, in its physical form and mostly accompanied by a description, in this case the artifact is completely absent and only represented. The necessity of its absence created the opportunity for alternative views, while having the artifact available designers might feel that further representations can be redundant, but, we argue, this redundancy might offer further information and reading keys. For example, through illustration, we synthesize similar balconies under the same group. Due to their level of abstraction, in fact, two different balcony balustrades might present the same structure and differ only in minor aspect if at all. Their uniqueness is challenged within one type of representation but highlighted within another one. In fact, in the 360° photography, the location of the building and the building architecture become dominant and shows the balustrades in their unique location and configuration within the facade. The perception of immanence and stability in architecture is lost in this transient translation to represented media and simultaneously preserved as many of these balustrades are already being destroyed and replaced. This character of transience is also communicated through the mobile+wall display where the access to raw information means also the temporality of their state as the content is updated and transformed. During the exhibition, multiple updates were done to improve the validity of data.

## 4.4 From Model to Exhibition

The exhibition aim was to bring up an interdisciplinary collaboration and explore possible novel areas of interaction ecologies with collections of architectural elements. This model guided the design of the exhibition by establishing a set of aims and criteria to be followed and might suggest to other curators and designers the possibility to implement it in exhibition aiming at similar results. The criteria, analysed in the previous paragraphs, were discussed in relation to the observation of people's behaviour and the brief interviews done during the days of the exhibition. These qualitative observations are influenced by a limited audience that, due to the time and condition (the exhibition was the first public activity in the Architectural Centre of Izmir after the lockdown and distancing times imposed by Covid-19), was mostly composed of academicians in the fields of architecture and design who were explicitly invited. Further analysis is then left to future studies but a series of key-points can be highlighted as to form a starting structure for other researchers to adopt the model and verify it as well as improve it.

From the perspective of interaction ecologies, the creation of an assembly [13, 16] or a cross-device interaction experience require some important investment in terms of technological development causing sometimes the inhibition of experimentation or the possibility of correcting the installation on site. Consequently, anticipating and planning the roles of devices and people becomes a fundamental activity. Within this planning it is important to consider proximity and usage of space. As is is observed in Reference [33]: "People came with companions and explored the exhibition together while others were in the same gallery," "People standing at some distance from the projection rarely move sufficiently to trigger noticeable changes to the picture," and "the space around the installation is reconfigured; the people who have just arrived at the installation forming a semicircle around the installation including the couple interacting with it. They see the projection in the light of the couple's actions in front of it [. . .]." These observations of people's behavior within the exhibition show a mix of of social, spatial, and technological contexts that we tried to anticipate within our model. For example, multiple times people appeared uninterested in the 360° walk while trying to figure out the abstract map of Ankara without reaching their own device to scan the QR markers; this might have been for technological limitation reluctance and somewhat lack of expectation regarding the result of that action. The interest was often raised by someone else starting to interact with the installation. These observations were verified when people asked each other or directly the exhibition team for technological support or explanation. After this onboarding process, most of the visitors became independent explorers of the walk with only few cases in which, still avoiding use of their own smartphones, they started suggesting other people to show them the balconies of a different region, in fact directing them to be their own personal guide. The presence of other people surrounding the visitor helped

their own experience and the observation and different roles created a dialogue among people. Similar relations were developed, as already mentioned, in front of the mobile+wall display. Surely the technical limits of the on-boarding phase could be implemented differently to facilitate a more immediate action but such processes are becoming more familiar to a broad audience. The speed of adoption of QR markers spiked during the Covid-19 pandemic as it became a popular techniques adopted to reach digital menu to replace their printed counterpart in restaurants and cafes.

Under the lens of exposing collections, the possibilities offered by multiple representation and openness of the data offer the audience a space of reflection and interpretation, a space that is minimally directed. The exhibition becomes a tool for exploration that can be exploited for as much time as the audience wishes to accordingly gain more information. Offering these exploration possibilities gives the opportunity to adapt the style of visit to the personal interest, as an architect might spend more time observing constructive details and relation with the building, while a historian might attempt to observe the region as a social texture and its evolution and character in the given time, maybe comparing to today's ongoing transformations. Furthermore, the audience can constitute their own reading based on this direct contact with the data. This exposition of the collection can be replicated in other contexts to offer a similar range of experiences through different explorative tools to different audience profiles.

The process of becoming an ephemera, as demonstrated here for architectural elements, might be equally translated to other fields and contexts. Offering an extended view of an artifact or of the relations among artifacts is one of the core reasons to adopt digital technologies in GLAM. For this reason, we believe it is important to include refraction and transiency within the conceptual toolbox of the designer. The creation of multiple representations of one artifact increases the information offered to the audience and brings them to see things differently. As in a broken mirror the fragmentation of view allows the observer to catch several details instead of the composed general picture. With the creation of multiple representations, different aspects of the artifact become more apparent or recede in the background. In our observation, people treated the illustration almost as pure abstract patterns without the balconies' balustrades and were intrigued when they compared them with their photographic representation where materiality emerged offering a more real and physical dimension. Within the mobile+wall display, one aspect of this ephemeralization was the possibility offered to see the balconies within the map so rooted in the reality of their position as well as in a photo-gallery where balconies were juxtaposed, creating again a more transient feeling, a feeling that the balconies were there and yet far.

## 5  CONCLUSION

In this study, we introduced a model for observing and designing interaction ecologies with the aim of exposing a collection of architectural ephemera. We defined interaction ecologies as the approach to a context in which individuals of different species (devices and humans included) entertain rich and floating relationships appropriate to the roles, activities, and postures they assume. The roles assumed by the different species, the relationship entertained among them, and the flexibility of the context are taken as central aspects to develop. We introduced the concept of exposing collections as an approach to exhibition that prefers active exploration and access to the raw data of a collection. We defined architectural ephemera as that process of translation of architectural elements into transient artifacts that support the preservation of memory through refraction. We then structured the prototype of an exhibition following these theoretical requirements.

The interaction ecology obtained favors interaction among people and devices and the alternation of roles among them. The mobile phone becomes exhibition area, remote controller, and mechanical eye. The visitor becomes at times an actor, a bystander, a performer, a participant, someone that entertains relations with people and devices while influencing the context in which they are navigating. Their physical position, posture, and attitude literally stand on the exhibition and manifest their actions. Walking, observing, talking are blended in a familiar way to visitors of GLAMs and "co-visitors use awareness of each other's interaction with exhibits

as a resource for their interaction with each other, and use interaction with each other as a resource for their interpretation of the exhibits" [12]. In fact, we observed people getting each other's support technically, where onboarding was still challenging, as well as motivational where the surprise of a visitor extended to the neighbor still skeptical to take out their phone and try out the experience. We would like to draw a few notes of commentary regarding the design decision that positively impacted the exhibition but that fall beyond the theoretical background. The study was planned before Covid-19 pandemic, and different techniques were considered as the adoption of touch-based devices. This option was consequently excluded in favor of a touch-free experience where people could navigate through the space and the collection without any external contact other than their own phones. A secondary consequence of this decision was a reduction of costs. This benefit extends the possibility for this prototype to be applied in a different context where more limited budgets or expensive hardware are not available. The hardware needed, thanks to the adoption of BYOD, is limited to one PC, one modem as access point and two projectors. In the space of a museum or a longer term installation, this limited amount of devices can be a cost benefit, as limited device maintenance or renewal is needed. Furthermore, this element of scarcity is also positive in terms of sustainability as ecological footprint because, apart from the introduction poster and two small guide prints, no material was printed nor hanging display systems were produced.

This model aims at increasing the designer toolbox by supporting their decisions with a richer conceptual toolbox and providing extended experiences to broader audiences. As illustrated in the fourth part, while the prototype directly refers to the qualities of exposing collections through interaction ecologies and specifically to architectural ephemera, the design and curatorial decisions taken can be transferred and translated in different contexts, making the model a tool for designing as well as observing other exhibitions. For designers and curators the adoption of our model means the inclusion in their practice of reflections such as: How does this installation consider the presence of several people and their different position, role, actions? How do the devices adopted create a relation among themselves and a coherent narration? How can the audience explore the contents of the exhibition and how are the data made available? How many different representations of the artifacts are exhibited and what do they tell us? In our opinion, the adoption of such a model causes a simple shift that carries rich consequences for the curation and design of exhibitions.

Next to these positive results in our observation, a few challenges emerged that still need to be tackled. The decision of not having printed materials influenced the expectations of the audience looking for a more "traditional" exhibition. The delicate balance of offering raw data similarly gave the feeling of what a visitor described as "a kitchen without a ready dish." While this could be a good description of our intentions, in further studies, a wider contribution of the participants in the form of citizen curatorship as well as a different organization of the ingredients could serve as a better invitation to make them fully become chefs.

## ACKNOWLEDGMENTS

## REFERENCES

[1] Hermina G. B. Anghelescu and John H. Slate. 2001. Visual ephemera: A selected bibliography. *Collect. Manag.* 25 (7 2001), 77–80. DOI:https://doi.org/10.1300/j105v25n04_08

[2] Mieke Bal. 1999. Introduction. In *The Practice of Cultural Analysis: Exposing Interdisciplinary Interpretation.* Stanford University Press, Stanford, Chapter 1, 1–14.

[3] Gregory Bateson. 2000. *Steps to an Ecology of Mind* (2nd ed.). University of Chicago Press, Chicago.

[4] Ian Bogost, Simon Ferrari, and Bobby Schweizer. 2010. *Newsgames: Journalism at Play.* The MIT Press, Cambridge, MA. DOI:https://doi.org/10.7551/mitpress/8854.001.0001

[5] Gui Bonsiepe. 1999. *Interface: An Approach to Design*. Jan Van Eyck Akademie, Maastricht.

[6] Stephen Boyd Davis and Olivia Vane. 2019. Design as externalization: Enabling research. *Inf. Des. J.* 25 (12 2019), 28–42. DOI:https://doi.org/10.1075/idj.25.1.03van

[7] Frederik Brudy, Christian Holz, Roman Rädle, Chi-Jui Wu, Steven Houben, Clemens Nylandsted Klokmose, and Nicolai Marquardt. 2019. Cross-device taxonomy: Survey, opportunities and challenges of interactions spanning across multiple devices. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI'19)*. Association for Computing Machinery, New York, NY, 1–28. DOI:https://doi.org/10.1145/3290605.3300792

[8] Frederik Brudy, Nicolai Marquardt, Yvonne Rogers, Abigail Sellen, and Kenton O'Hara. 2016. The challenges of using an existing cross-device interaction prototype for supporting actual curation practices. In *Proceedings of the Cross-Surface Conference*.

[9] Luis Emilio Bruni, Enrico Daga, Rossana Damiano, Lily Diaz, Tsvi Kuflik, Antonio Lieto, Aldo Gangemi, Paul Mulholland, Silvio Peroni, Sofia Pescarin, and Alan Wecker. 2020. Towards advanced interfaces for citizen curation. In *Proceedings of the Workshop on Advanced Visual Interfaces and Interactions in Cultural Heritage (AVI2CH'20)*. Retrieved from http://oro.open.ac.uk/72524/.

[10] Levi R. Bryant. 2014. *Onto-cartography: An Ontology of Machines and Media*. Edinburgh University Press, Edinburgh.

[11] Jim Burant. 1995. Ephemera, archives, and another view of history. *Archivaria* 40 (1 1995), 189–198. Retrieved from https://archivaria.ca/index.php/archivaria/article/view/12105.

[12] Matthew Chalmers and Areti Galani. 2004. Seamful interweaving: Heterogeneity in the theory and design of interactive systems. In *Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques (DIS'04)*. Association for Computing Machinery, New York, NY, 243–252. DOI:https://doi.org/10.1145/1013115.1013149

[13] Mike Fraser, Danaë Stanton, Kher Hui Ng, Steve Benford, Claire O'Malley, John Bowers, Gustav Taxén, Kieran Ferris, and Jon Hindmarsh. 2003. Assembling History. In *ECSCW 2003*, Kari Kuutti, Eija Helena Karsten, Geraldine Fitzpatrick, Paul Dourish, and Kjeld Schmidt (Eds.). Springer Netherlands, Dordrecht, 179–198.

[14] James G. Gibson. 1986. *The Ecological Approach to Visual Perception*. Psychology Press, New York, NY.

[15] K. Wm. Hall, C. Perin, P. G. Kusalik, C. Gutwin, and S. Carpendale. 2016. Formalizing emphasis in information visualization. *Comput. Graph. Forum* 35, 3 (June 2016), 717–737.

[16] Eva Hornecker and Luigina Ciolfi. 2019. Human-computer interactions in museums. *Synth. Lect. Hum-cent. Inform.* 12, 2 (11 Apr. 2019), i–171. DOI:https://doi.org/10.2200/S00901ED1V01Y201902HCI042

[17] Priscilla Jimenez Pazmino and Leilah Lyons. 2011. An exploratory study of input modalities for mobile devices used with museum exhibits. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'11)*. Association for Computing Machinery, New York, NY, 895–904. DOI:https://doi.org/10.1145/1978942.1979075

[18] Klaus Krippendorff. 2005. *The Semantic Turn: A New Foundation for Design*. CRC Press, Boca Raton, FL.

[19] Klaus Krippendorff and Nour Halabi. 2020. *Discourses in Action*. Routledge, Abingdon.

[20] Peter Lyle, Henrik Korsgaard, and Susanne Bødker. 2020. What's in an ecology? A review of artifact, communicative, device and information ecologies. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction*. Association for Computing Machinery, New York, NY. DOI:https://doi.org/10.1145/3419249.3420185

[21] Kate McLean. 2017. Mapping the invisible and the ephemeral. In *The Routledge Handbook of Mapping and Cartography*. Routledge, Abingdon, Chapter 37, 500–515.

[22] Melissa McMullan and Joanna Cobley. 2017. Lessons in ephemera: Teaching and learning through cultural heritage collections. *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage* 18, 2 (2017), 93. https://doi.org/10.5860/rbm.18.2.93

[23] Merriam-Webster. 2022. Refraction. In *Merriam-Webster.Com Dictionary*. Merriam-Webster, Springfield, MA. Retrieved from https://www.merriam-webster.com/dictionary/refraction.

[24] OpenStreetMap contributors. 2017. Planet dump retrieved from https://planet.osm.org. Retrieved from https://www.openstreetmap.org.

[25] Daniela Petrelli, Elena Not, Areti Damala, Dick van Dijk, and Monika Lechner. 2014. meSch - material encounters with digital cultural heritage. In *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection*, Marinos Ioannides, Nadia Magnenat-Thalmann, Eleanor Fink, Roko Žarnić, Alex-Yianing Yen, and Ewald Quak (Eds.). Springer International Publishing, Cham, 536–545.

[26] Felipe Pezoa, Juan L. Reutter, Fernando Suarez, Martín Ugarte, and Domagoj Vrgoč. 2016. Foundations of JSON schema. In *Proceedings of the 25th International Conference on World Wide Web (WWW'16)*. International World Wide Web Conferences Steering Committee, 263–273. DOI:https://doi.org/10.1145/2872427.2883029

[27] Yvonne Rogers. 2006. Moving on from Weiser's vision of calm computing: Engaging UbiComp experiences. *Lect. Notes. Comput. Sci.* 4206 (2006), 404–421. DOI:https://doi.org/10.1007/11853565_24

[28] Daniele Savasta and Elif Kocabıyık. 2021. Designing a Computational Interface for the Study of Collections: 'Grouper' as a Research Tool. In *NERD - New Experimental Research in Design 2*, Michelle Christensen, Wolfgang Jonas, and Ralf Michel (Eds.). Birkhäuser, Berlin, 120–145. https://doi.org/10.1515/9783035623666-010

[29] Daniele Savasta and Zeynep Tuna Ultav. 2022. *Ankara Balkon Korkulukları 1950–75*. Yasar University. DOI:https://doi.org/10.5281/zenodo.6371382

[30] J. Mark Schuster. 2001. Ephemera, Temporary Urbanism, and Imaging. In *Imaging the City: Continuing Struggles and New Directions*. Routledge, Abingdon, 361–396.

[31] Oliviero Stock and Massimo Zancanaro. 2007. *PEACH-Intelligent Interfaces for Museum Visits*. Springer, Berlin.

[32] Dirk Vom Lehn and Christian Heath. 2003. Displacing the object: Mobile technologies and interpretive resources, In International Cultural Heritage Informatics Meeting: Proceedings. *Arch. Mus. Inform.* 3 (2003).

[33] Dirk vom Lehn, Jon Hindmarsh, Paul Luff, and Christian Heath. 2007. Engaging constable: Revealing art with new technology. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'07)*. Association for Computing Machinery, New York, NY, 1485–1494. DOI : https://doi.org/10.1145/1240624.1240848

[34] Annika Wolff and Paul Mulholland. 2013. Curation, curation, curation. In *Proceedings of the 3rd Narrative and Hypertext Workshop (NHT'13)*. Association for Computing Machinery, New York, NY. DOI : https://doi.org/10.1145/2462216.2462217

[35] Henrik Enquist, Konrad Tollmar, and Aino Vonge Corry. 2007. Interaction Ecologies. In *Workshop Proceedings from the Fifth International Conference on Pervasive Computing. Design Semiotics in Use. SeFun International Seminar*. Helsinki, 11 pages. http://www2.uiah.fi/sefun/DSIU_papers/DSIU_Enqvist%20_%20Interaction%20Ecologies.pdf .