

Getting Hold of the Urban Chameleon—Towards a Platform for Graffiti Visualisation and Analysis

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Abstract

This paper presents Urban Chameleon, an online platform currently developed within INDIGO, an academic project that aims to inventory, disseminate, and analyse contemporary graffiti along the *Donaukanal* (Eng. Danube Canal) in Vienna, Austria. Urban Chameleon serves as a digital space to visually and analytically explore these graffiti. The paper provides an in-depth overview of the platform's development process, including data modelling underpinnings and Web development technologies. The text further discusses the platform's potential applications for researchers, heritage professionals, graffitiists and the wider public interested in engaging with the vibrant and dynamic graffiti-scape along the Danube Canal. In that way, the article contributes to the ongoing discourse on graffiti as a multi-faceted, modern cultural practice with heritage value.

Keywords

Cesium; Contemporary graffiti; Cultural heritage; JavaScript; Spatial and temporal context; Visualisation; Wireframe

1. Introduction

Graffiti comes in many forms: from ancient inscriptions and symbols, historical etchings, verbal and non-verbal street scribbles to contemporary graffiti writing and street art. Some of those graffiti categories have increasingly been recognised as cultural heritage. This recognition has led to a growing trend towards preserving and restoring graffiti, especially older graffiti manifestations and works considered street art. However, the ephemeral nature of graffiti presents a challenge to their physical preservation as they are often visible for only a short period and confined to their location of creation. To address this challenge, online platforms that digitally archive and disseminate graffiti have emerged as a promising solution. One such platform, Urban Chameleon, is the topic of this paper.

The online Urban Chameleon platform is currently created within project INDIGO. As its acronym reveals, INDIGO aims to IN-ventory and DI-sseminate G-raffiti along the d-O-naukanal (Eng. Danube Canal) in Vienna, Austria (Verhoeven et al., 2022). The platform serves a dual purpose: it should be a virtual environment for visualising and disseminating all graffiti digitally documented within the two-year project and enable their comprehensive analysis by everybody interested in graffiti. This aim lets the online platform touch upon the five research pillars of project INDIGO: acquisition, processing, management, dissemination and analysis (see Figure 1). By incorporating the Danube Canal's three-dimensional (3D) surface geometry and detailed temporal metadata for each graffiti, the platform seeks to spatially and temporally

contextualise the graffiti. Urban Chameleon will place the digital graffiti approximations (either an orthophoto or a texture on the 3D model; see Wild et al. (2023)) into their original albeit digitised environment, thereby accounting for the intentions of the graffiti creators. The combination of such detailed visualisation with extensive metadata querying seeks to offer unique opportunities for researchers, graffitiists, and the general public to engage with the rich graffiti heritage at the Danube Canal. At the time of writing (July 2023), the platform (<https://www.urbanchameleon.eu>) is accessible but still under construction.

This paper will first discuss the dissemination of graffiti on the World Wide Web (WWW or Web) to provide the necessary background against which INDIGO's Urban Chameleon platform must be seen. Afterwards, a comprehensive description of the platform's iterative and incremental development methodology is presented. Overall, the paper provides insights into the development of Urban Chameleon as a platform for online sharing, visualising and analysing graffiti, thereby contributing to the ongoing discourse on the significance of graffiti as cultural heritage.

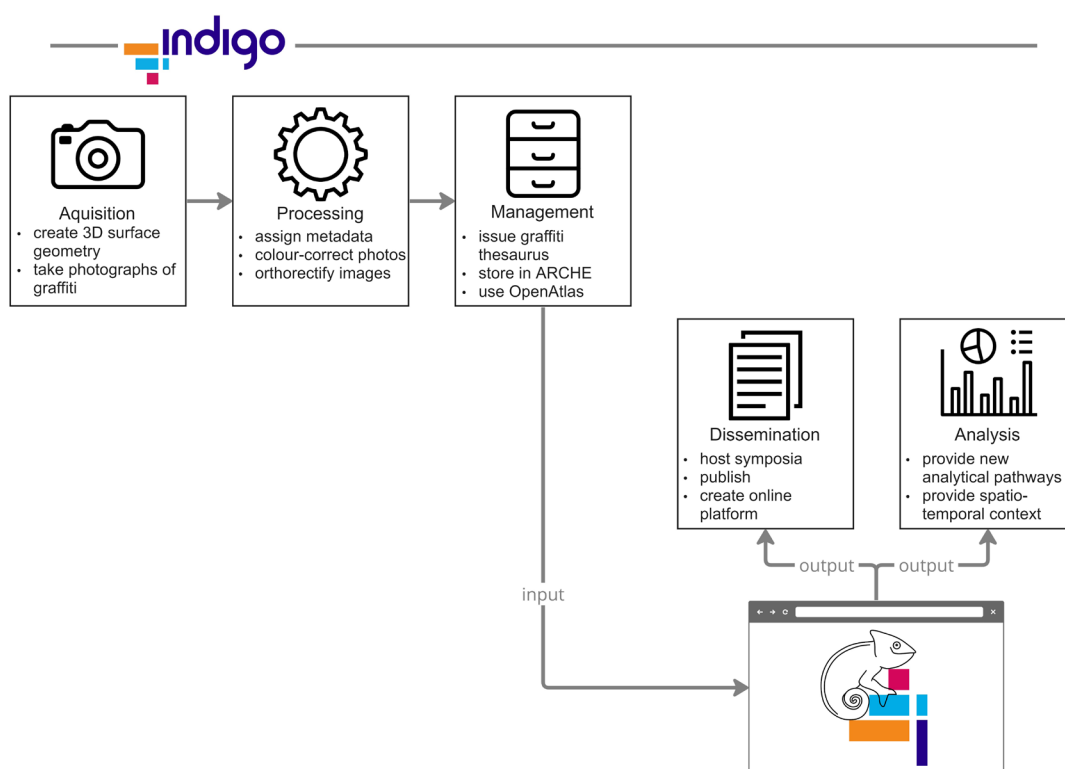


Figure 1. The online platform Urban Chameleon situated in project INDIGO's research structure.

2. Background

The history of graffiti is as diverse as their creators. From millennia-old animal rock drawings to political statements scratched in ancient Roman wall plaster to the vibrant murals of modern urban landscapes, graffiti have generally served as a mirror of society, reflecting the thoughts, feelings, and experiences of individuals and communities (Ganz, 2021). In their myriad forms, graffiti have been driven

by many motivations, including artistic expression, political activism, personal proliferation and social communication. Various factors influence these motivations, such as the environment, emotions, becoming more knowledgeable and skilful, technology, and aesthetics. Artistic expression holds a central position among these motivations because graffiti provide a medium for self-expression, enabling individuals to assert their individuality and mark their presence (Sturdy

Colls et al., 2019). This aspect of graffiti is intrinsically linked to its function in social communication. As a conduit for transmitting messages, emotions, and ideas, graffiti catalyse interaction within a community (Pérez-Izaguirre & Reglero, 2023).

Furthermore, many creators use graffiti to showcase their originality and technique, thereby transforming urban landscapes into a testament to their creative prowess (Harding, 2019). Simultaneously, graffiti serve as a platform for political activism (Waldner & Dobratz, 2013), provoking discourse via political messages and symbols. They can also act as a form of social commentary, reflecting the social and cultural issues of a particular time and place (Kolmakova & Shalkov, 2021). Graffiti often invite viewers to dialogue with the work, and they always add a new layer to the urban landscape (Gartus & Leder, 2014; Waldner & Dobratz, 2013).

This multi-faceted nature has led to a gradual shift in the perception of modern graffiti over the past two decades. Once dismissed as mere acts of vandalism, some graffiti are now gradually recognised for their social and cultural significance, prompting a growing trend towards preserving and restoring the physical graffiti (Amor Garcia, 2023; Cortea et al., 2021; Thomas & Nicholas, 2020). However, the preservation of graffiti presents unique challenges. Unlike traditional artworks protected within museums or galleries, graffiti are vulnerable to weathering, urban development, and interference from other graffiti artists (Avrithis et al., 2010). The ephemeral nature of graffiti, often seen as an inherent characteristic of this form of expression, raises questions about the ethics and feasibility of preservation. But should all graffiti be preserved, either in their original locations or as digital surrogates, or should graffiti-safeguarding be limited to those deemed significant by specific standards? And who gets to decide what is worth preserving and how (Dovey et al., 2012)?

This is where the advent of the WWW on the Internet (from now on Web) has played a transformative role. Prior to the Web, photos of graffiti were shared through physical mediums such as magazines, zines, books, movies, and blackbooks. While these mediums were effective, they had limited reach

and accessibility. Being open, cost-effective, and ubiquitous, the Web offered unprecedented reach by removing most existing geographical constraints (Dourisboure et al., 2007). Graffiti artists, researchers and interested parties could now easily share and exchange photos once they were digitised. In that sense, the advent of the Web kickstarted the digital documentation of graffiti. This digital shift not only enabled graffiti artists to gain recognition and exposure on a scale unachievable with traditional physical mediums (Wyatt, 1997), but it also led to the creation of digital graffiti archives (Chen et al., 2022). Websites like Art Crimes (<https://www.graffiti.org>) and Spraycity (<https://spraycity.at>) have been instrumental in documenting graffiti for over two decades, allowing graffiti to reach a global audience and expand the influence of this expression form.

Even though graffiti artists could use these initial websites (and e-mail) to connect and foster a global graffiti community (Veenendaal, 2016), that gained even more momentum when, at the dawn of the 21st century, social media platforms emerged (1997: Six Degrees; 2001: Friendster; 2003: MySpace; 2004: Flickr). Rudimentary at first, they continuously grew in functionality, ease of use, and addictiveness. Today, the role of social media platforms, particularly Instagram, in shaping cultural and symbolic practices is well established. Meta's Instagram—launched in 2010—has become a popular platform for graffiti creators, influencing how they create and share their work (MacDowall, 2019). For example, the platform's former emphasis on square-format images introduced compositional graffiti changes to better fit this format (La Rocca & Boccia Artieri, 2022).

Crowdsourcing platforms represent the most recent approach to increasing online engagement with graffiti. Instead of the structured but expert-collected photo collections of archival websites or the more random photos posted on social media, platforms like Street Art Cities (<https://streetartcities.com>) or the George Floyd and Anti-Racist Street Art Archive (<https://georgefloydstreetart.omeka.net>) involve the general public to collect graffiti-related data. Those data—usually photographs—are subsequently processed and disseminated by the platform owner. This participatory aspect further

helps to improve the recognition and appreciation of graffiti as a relevant social and cultural heritage (Ridge, 2013).

The combination of social media and dedicated, occasionally crowdsourced graffiti websites digitally immortalised and popularised the transient graffiti world, profoundly changing how humans worldwide connect with graffiti. Together with the online manifestations mentioned above, initiatives like Vagabundler (<https://vagabundler.com>), Street Art Bio (<https://www.streetartbio.com>), and the Conservation of Public Urban Space (CaPUS) project (<https://www.capusproject.eu>) do not only offer graffitiists an avenue to extend their reach beyond their local communities, but they also provide unique opportunities for non-graffiti creators to visualise, find, research, and appreciate graffiti. These are also the goals set by the INDIGO team for the online Urban Chameleon platform. Although Urban Chameleon will only focus on graffiti along Vienna's Danube Canal, the platforms underlying Web technologies and the detail provided per graffiti aim to open new pathways to visualise and analyse graffiti. The following section will outline the (currently still ongoing) development of the Urban Chameleon platform.

3. Methodology

In website development, a circular approach refers to an iterative process involving several stages: analysing, planning, designing, testing as well as deploying, getting feedback, and re-analysing (see Figure 2). This approach is the core of so-called Agile management, often used to manage software projects. Agile management focuses on continuous improvements and incorporates feedback with every iteration (Ríos & Pedreira-Souto, 2019). Developing a website using an Agile approach is comparable to creating a graffiti like a mural, where the graffitiist sketches, paints, steps back to review, adjusts, and repeats the process. This flexibility and adaptability starkly contrast with the traditional Waterfall management model, which is more akin to a pre-planned stencil graffiti: the design is created, the stencil is cut, and the paint is applied; there is little room for modification once a stage has been completed. The Agile methodology with its circular development philosophy was selected for the INDIGO project due to its capacity for ongoing refinement and improvement of the platform based

on user feedback and evolving needs. It is a more flexible approach that can adapt to changes, much like the ever-evolving culture of graffiti itself.

The first stage in the circular approach, analysis, involves gathering the requirements and understanding the needs of the platform's users and its general purpose. In the context of project INDIGO, this involved researching the demands, wishes and preferences of graffiti creators, researchers, and enthusiasts, as well as examining existing initiatives for documenting, sharing, analysing and understanding graffiti. The information gathered during this stage was used to outline the online platform's goals, scope and data input. The design stage then focused on creating the wireframe and developing prototypes to visualise the platform's layout and functionality. This part is influenced by the analysing and planning stage and should ideally result in a user-friendly interface that supports the platform's objectives. Once the design is finalised, the website gets tested and published (i.e., deployed.) Feedback from users—especially researchers—will then be collected and analysed to identify areas for improvement. This feedback informs the website's next iteration, thus starting the cycle again (Hu et al., 2008). In this way, INDIGO hopes to develop a flexible and adaptable online platform that can evolve in response to the needs of its users. The following sections provide more details on each of these development steps. Figure 2 can thereby feature as a guideline.

3.1 Analysing the Field of Graffiti

Graffiti encompass a large spectrum of mark-making content, from textual to pictorial, and spans from prehistory to the contemporary era. Graffiti have been discovered in various contexts, such as the necropolis at Saqqara in Ancient Egypt, the caves of Lascaux in France and Altamira in Spain, the Roman town of Pompeii and the urban landscapes of modern cities (Ganz, 2021). This heterogeneity has led to the involvement of various scholarly disciplines, each of them interrogating this diverse world of graffiti from their particular perspective: How do graffiti reflect the current political situation? Which are the dominant colours in a graffiti-scape? Are subversive symbols crossed (i.e., covered) quicker than pieces? Which linguistic constructions do graffiti

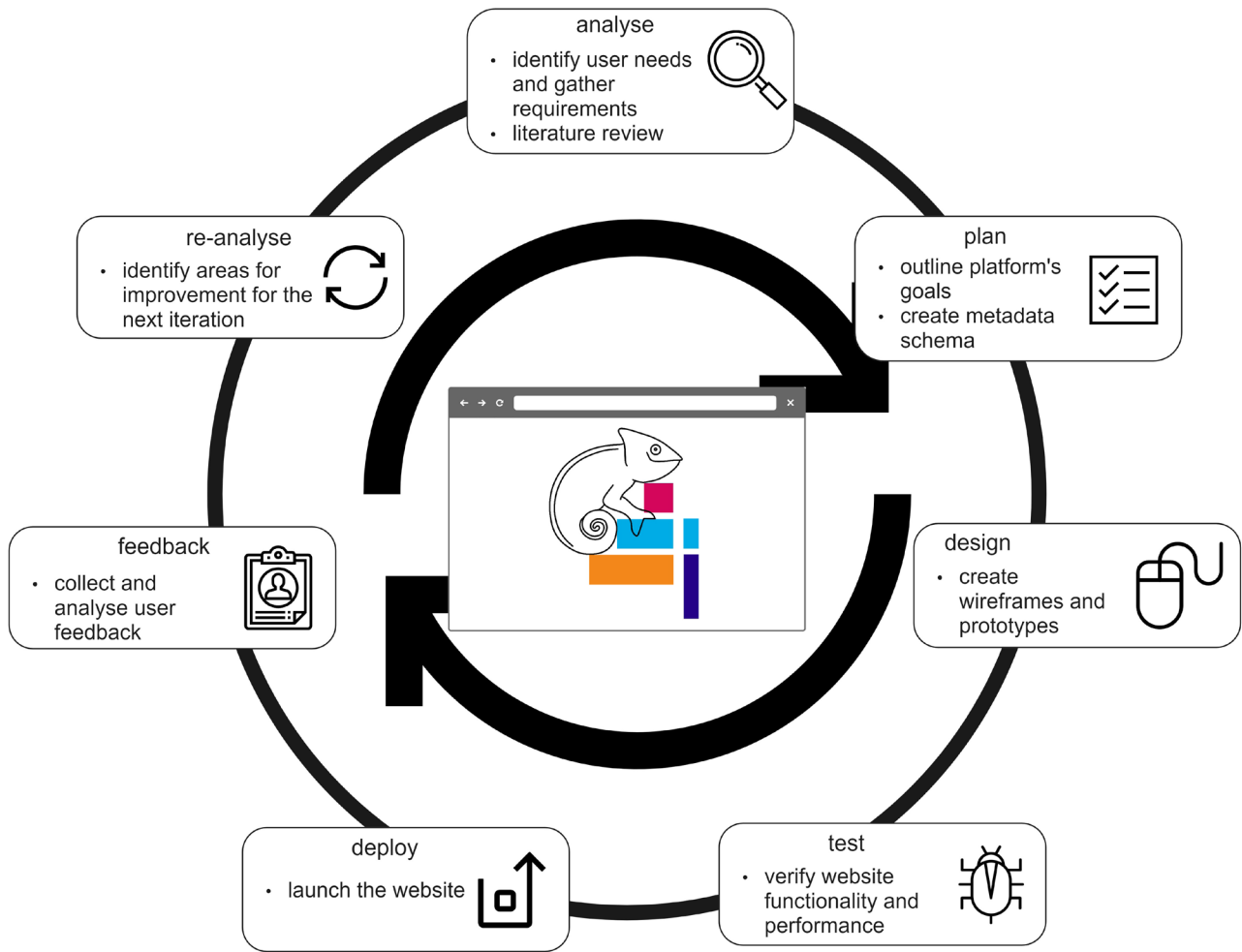


Figure 2. The circular approach (Agile development method) followed within project INDIGO for creating the online Urban Chameleon platform.

predominantly use? INDIGO tries to account for research questions like these during the platform development phase. For example, the possible database queries and graffiti-specific metadata must facilitate many of these analytical pathways if the Urban Chameleon platform should be useful to as many academic fields as possible.

To this end, a systematic literature review was conducted within the framework of project INDIGO (see Figure 3). This involved a comprehensive examination of scholarly writings, non-academic grey literature, and other relevant sources to identify and understand the key concepts, theories, and

practices related to graffiti. For instance, all possible graffiti terms and concepts were noted down to create a graffiti thesaurus (Schlegel et al., 2023). Developing a thesaurus significantly contributes to any research field, as it provides a standardised, hierarchically structured, comprehensive vocabulary for descriptions, interpretations, and analyses. A generally accepted thesaurus does not exist in the research field of graffiti, which may be attributed to graffiti's diverse and complex nature. The INDIGO graffiti thesaurus aims to fill this gap by following the faceted and hierarchical structure of the Getty Art & Architecture Thesaurus (AAT). Not only does the AAT provide a well-established structure

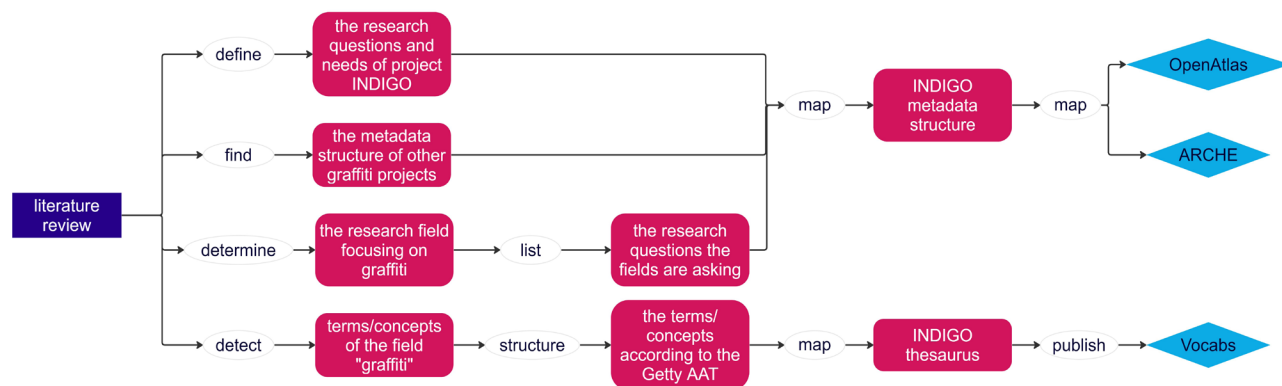


Figure 3. The workflow followed to analyse the graffiti research field (indigo-blue square: method; pink rounded squares: steppingstones; blue diamonds: ACDH-CH service tools).

and consistent framework that is also applicable for categorising and describing graffiti, modelling the INDIGO graffiti thesaurus according to the AAT also enhances its interoperability due to easier integration with other systems and databases that already rely on the AAT (see also Schlegel et al. (2023)). Moreover, the thesaurus ensures that terminology is used consistently throughout the Urban Chameleon platform. And since everybody can quickly check the thesaurus for the exact meaning and scope of every term used on the platform, it enhances the accuracy, efficiency and consistency of information retrieval.

In addition to the thesaurus, a graffiti metadata schema is being developed to capture the relevant information about each graffito (see Figure 3). Metadata, often referred to as 'data about data', provide a detailed description of the physical graffiti and its digital approximations (like a photograph) to enhance their understanding and interpretation (Borgman, 2015; Pomerantz, 2015). For example, metadata elements could be the creator and geographical location of the graffito, the approximate moment of graffito production and the materials utilised, the photographer's name and camera model used to take the photo, the graffito's surface area and dominant colour. A metadata schema is a structured framework that outlines which elements must be collected and how they should be formatted and organised (Caplan, 2003). A comprehensive and well-thought metadata schema not only aids in organising and retrieving graffiti facts but

also holds the potential to provide valuable insights into the various social, political, cultural and historical aspects of graffiti.

In the scope of project INDIGO, the development of the metadata schema began by analysing the metadata schemas from the Ancient Graffiti Project (The Ancient Graffiti Project, 2023), Art Crimes (Art Crimes and the artists, 2022), INGRID (INGRID, 2019), Spraycity (SprayCity, 2023) and consulting specific resources like the Catalogue for Cultural Objects (Mugridge, 2007). All schemas were collected and compared in a spreadsheet to gain insights into the information typically recorded about graffiti and cultural objects on the one hand, and the structure and organisation of this information on the other. Additionally, the INDIGO metadata schema was informed by the research questions posed by different disciplines interested in graffiti, as identified in the literature review. For example, a historian might be interested in the date and location of a graffito, while a linguist would instead focus on the graphemes and language used. Therefore, the metadata schema must accommodate a wide range of information to cater to these diverse research interests.

Based on these requirements, a first metadata schema was created. Several people then reviewed this draft, which got revised based on their feedback. As of July 2023, the metadata schema is still not finalised but in an advanced

state. The schema still needs to be applied to a few graffiti test sets to ensure the metadata structure and elements are logical and exhaustive enough to meet the needs of the broader graffiti (research) community.

3.2 Planning–The data input

The planning stage must ensure that Urban Chameleon offers users a comprehensive, interactive, and user-friendly digital space for exploring and analysing graffiti. Creating and maintaining such an online space is only possible through sufficiently standardised management and storage of all (meta)data that form the backbone of Urban Chameleon. For these tasks, INDIGO relies on the Austrian Centre for Digital Humanities and Cultural Heritage (ACDH-CH; <https://arche.acdh.oeaw.ac.at/browser>), specifically its services Vocabs (<https://vocabs.acdh.oeaw.ac.at>), OpenAtlas (<https://openatlas.eu>), and ARCHE (<https://arche.acdh.oeaw.ac.at/browser>) (see Figure 3). Vocabs provides a platform for the collaborative creation, maintenance, and publication of controlled vocabularies such as the INDIGO thesaurus. This guarantees the accessibility of these controlled vocabularies and ensures their standardisation and interoperability across projects. OpenAtlas, an open-source database software, enables the management of research (meta)data from various fields of the Humanities. How (meta)data are structured within OpenAtlas is guided by CIDOC's Conceptual Reference Model or CRM (Filzwieser & Eichert, 2020). The CRM (Bekiari et al., 2022) is a standard ontology developed by CIDOC, the International Committee for Documentation of ICOM (International Council of Museums). CIDOC's CRM provides a shared semantic framework for storing heterogeneous cultural heritage (meta)data and information, so that different teams acquiring datasets on dissimilar topics could create databases that can be integrated (Niccolucci & Felicetti, 2018; Richards et al., 2023). Lastly, the certified data repository ARCHE (A Resource Centre for the HumanitiEs) offers a long-term hosting and dissemination platform for digital research data and resources from all Humanities fields. ARCHE will ensure the digital longevity of INDIGO's (meta)data. Since ARCHE also features its own, more generic metadata schema, INDIGO must also establish a mapping from its graffiti-specific metadata elements to the more confined set of ARCHE elements.

These three services, either independently or in conjunction, provide a comprehensive digital infrastructure for Humanities research, facilitating data management, standardisation, and dissemination. As detailed by Trognitz et al. in this volume, these services also allow for different data workflows, something project INDIGO will make good use of. What concerns the Urban Chameleon platform, all relevant photographic and 3D surface data must be cached locally on the Urban Chameleon server to support fluent data streaming to the user. Periodic queries to ARCHE will fetch all new and Urban Chameleon-relevant data for local server storage. All graffiti-relevant metadata can be fetched from OpenAtlas via an Application Programming Interface (API), a set of rules and protocols that allows different software or Web applications to communicate and interact. These data and metadata are then displayed and made queryable on the Urban Chameleon platform, enabling the discovery and analysis of the *Donaukanal's* graffiti-scape.

3.3 Designing

The initial step in the design process of a website or application should be the creation of a wireframe. A wireframe serves as a visual guide that delineates the skeletal structure of the website. It incorporates placeholders for content, navigation elements, and interactive features but does not include detailed design elements such as colours, fonts, or images. Wireframes act as a blueprint for designers, developers and stakeholders, enabling them to comprehend, visualise, and review the overall organisation and functionality of the website before significant time and resources are invested in its development (Robinson, 2018).

Wireframes are crucial in the design and development process of Urban Chameleon. For instance, consider the landing page's image gallery. The wireframe for this page outlines the location of the image gallery and indicates that the gallery's imagery is fetched via the OpenAtlas API (see Figure 4). The gallery displays the images in a carousel format via a "react-responsive-carousel" (<https://react-responsive-carousel.js.org>) library. In this context, a library is like a toolbox of pre-made code developers use to build their applications. This particular library works with React (<https://react.dev>), a comprehensive component-based

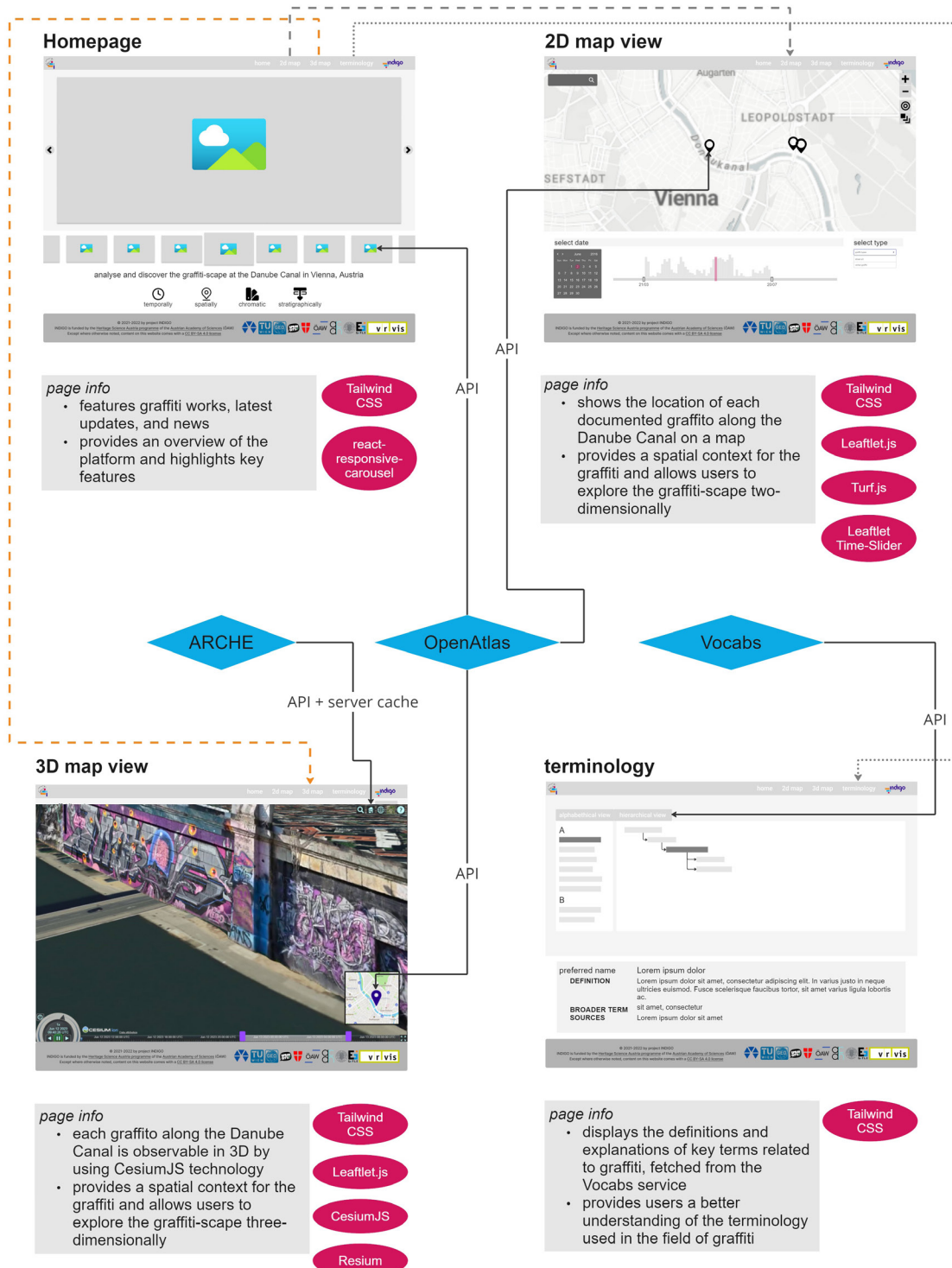


Figure 4. Wireframe of Urban Chameleon showing the data input (blue diamonds) and dependencies (pink ellipses) for every page.

open-source library popular for building user interfaces in a Web environment. React is based on JavaScript, a versatile programming language primarily used to make Web pages more interactive. JavaScript allows developers to control Web elements like forms and images; it is the backbone of modern Web applications. As a JavaScript library, React takes advantage of this flexibility and adds its own features. The carousel component is a good example of how React can help developers create dynamic and interactive Web

applications that update and render efficiently in response to changed user inputs or data availability.

Another technological cornerstone for Urban Chameleon is CesiumJS (<https://cesium.com/platform/cesiumjs>), an open-source and JavaScript-based geospatial library to work online with virtual globes and 3D maps. Besides conventional 2D maps, Urban Chameleon aims to offer visitors a digital 3D surface model of the entire *Donaukanal*.

Component	Type	Description	Benefits	Limitations	Choice Motive	Implementation
HTML	Markup Language	Creates Web pages	Universal, easy to use, supported by all browsers	Limited to static pages	Foundation of Web pages	Structures Web content
CSS	Style-Sheet Language	Styles HTML documents	Design flexibility, separates content from design	Requires understanding of inheritance and overriding	Controls layout of Web pages	Styles HTML elements
SCSS	Preprocessor	Extends CSS, adds features	Variables, nesting, mixins	Requires a build step	Enhances CSS functionality	Generates final CSS
JavaScript	Programming Language	Enables interactive Web pages	Interactivity, rich interfaces, versatility	Browser compatibility issues	Makes Web pages dynamic	Handles form validation, data processing
React	Library	Builds user interfaces	Component-based, fast rendering, SEO-friendly	Requires in-depth JavaScript knowledge	Develops complex UIs	Builds the user interface
TypeScript	Language	Superset of JavaScript, adds static types	Error detection at compile time, enhances code readability	Requires compilation	Enhances code reliability	Writes main application logic
Next.js 13	Framework	Enables server-side rendering, generates static web-sites	Performance benefits, fast refresh, data fetching	Requires React knowledge	Improves performance	Structures the Web application

CesiumJS	Library	Creates 3D globes and maps	High-precision rendering, feature-rich	Requires suitable hardware, up-to-date browser	Represents geographical context	Creates 3D globes and maps
Resium	Library	Wrapper for CesiumJS, used with React	Simplifies use of CesiumJS with React	Limited community, relies on CesiumJS	Facilitates use of CesiumJS	Integrates CesiumJS into the application
Potree	Library	Renders large point clouds in the browser	Handles large data, open-source	Requires suitable hardware	Creates 3D representation of environment	Renders large point clouds
Leaflet	Library	Creates mobile-friendly interactive maps	Easy to use, high performance, cross-platform	Requires plugins for advanced features	Lightweight, efficient	Implements interactive maps
React-Responsive-Carousel	Library	Carousel component for React applications	Customisable, responsive, supports swipe	Limited to React applications	Provides dynamic image viewing	Displays image gallery
Leaflet Time Slider	Library	Time slider plugin for Leaflet	Temporal-based filtering and visualisation	Requires time-based data	Enables temporal control over map data	Controls display of time-based data
Turf.js	Library	Performs spatial analysis, map manipulation	Modular, supports GeoJSON	Requires spatial analysis knowledge	Provides geospatial capabilities	Performs spatial analysis, map manipulation
Tailwind CSS	Framework	Utility-first CSS framework	Highly customisable, low specificity, responsive	Requires CSS knowledge	Allows rapid UI development	Styles the Web application

Table 1. This table summarises the programming languages, libraries (collections of pre-written code used for common tasks), and frameworks (structures dictating the architecture of the software) utilised for INDIGO's Urban Chameleon platform. Besides a general description, each technology's benefits, limitations, selection rationale, and specific role are outlined.

Whereas this surface model digitally represents the geometry of the graffiti-scape, all documented graffiti should be visualised via time-dependent texturing of this geometry.

In that way, Urban Chameleon hopes to facilitate virtual graffiti-scape walks through space and time. CesiumJS was chosen to make this entire experience responsive

and realistic. However, other libraries can enhance the capabilities of CesiumJS. Resium (<https://resium.reearth.io>), for instance, acts as a bridge between CesiumJS and React. It enables developers to incorporate the 3D mapping capabilities of CesiumJS within a React application, thereby combining the strengths of both libraries.

Besides CesiumJS, Resium and React, many other Web technologies will likely find their way into Urban Chameleon. Table 1 summarises all of them. The INDIGO team hopes this technological stack can facilitate a large, interactive online environment that allows one to query and download the underlying database of graffiti records on the one hand, and show those graffiti in a spatially and temporally accurate virtual context on the other. In that way, the online platform might enable a more comprehensive understanding and appreciation of graffiti as a form of cultural heritage (Statham, 2019; Ulutas Aydogan et al., 2021).

3.4 Test, Deploy, Feedback and Re-Analyse—An Outlook

The following steps are integral to developing and refining INDIGO's online platform and still follow Agile development methodologies. These stages ensure the platform undergoes comprehensive testing, is launched for public use, collects feedback, and implements necessary modifications. All steps still need to be worked out for Urban Chameleon, so here is an overview of what we envision.

The initial stage in this process, known as testing, involves various checks to confirm that the website functions as anticipated and meets the criteria set. This encompasses functional testing (which checks that all features are operating correctly), performance testing (which assesses the speed and responsiveness of the website), and usability testing to evaluate the user experience. Testing is critical to detect and rectify any issues or glitches before the website goes live (Pandey & Litoriya, 2020).

In Web development, deployment indicates the stage a website is made live and available for public use. This crucial step transitions the website from a private, controlled environment (often a developer's personal computer) to a server. A server can be considered a computer that hosts the

website and ensures that anyone on the Internet can reach the website anytime. The website's amount of data, traffic and functionalities determine how powerful the server has to be. The deployment process is meticulously carried out to guarantee that the website functions smoothly and consistently for all its users, regardless of when or where they access it (Kamepally & Nalamothu, 2016).

Third, user feedback is collected from researchers, graffitiists, stakeholders, and other relevant parties via surveys, user interviews, and website data analytics. Feedback is crucial as it provides insights into how users interact with the website. It identifies areas for improvement and validates the website's effectiveness in achieving its objectives (Koukopoulos & Koukopoulos, 2019). Based on this feedback, necessary adjustments to the platform's design, functionality, or content might follow. Overall, the Agile development approach adopted by INDIGO is particularly effective given the small team.

4. Conclusion

If project INDIGO manages to pull off the Urban Chameleon platform as envisioned, its data visualisation, sharing and querying capabilities will mark a significant advancement in the Digital Humanities, particularly for graffiti studies. To that end, the INDIGO team is currently integrating advanced Web development technologies with a graffiti-specific metadata schema and thesaurus, all on top of the latest standards in semantic data structuring and long-term storage. In the end, the authors hope that it all comes nicely together so that Urban Chameleon can provide a comprehensive, interactive, and user-friendly digital space for the digital exploration and analysis of an entire graffiti-scape over time. However, the entire platform development process is not a simple linear process. Many hurdles (often in the form of bespoke, iterative developments) must be taken along the way. This paper mentioned some of these developments; additional ones form the topic of other contributions in this volume (such as the temporal reasoning approach and image segmentation tool, respectively reported by Verhoeven, Schlegel & Wild and Verhoeven, Wieser & Carloni).

Conflict of Interest

The authors declare no conflict of interest.

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