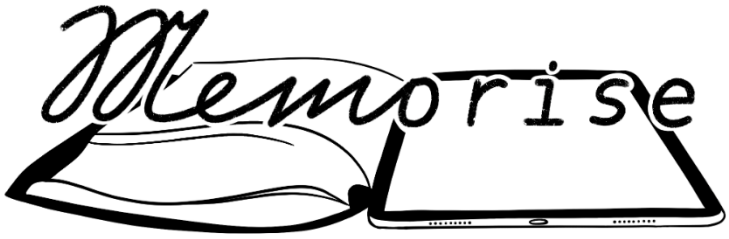

Deliverable D5.1 Module for user state acquisition and estimation: relevant system indicators, high-level features

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Objective(s) of D 5.1

The objective of D 5.1 at this stage is focused on defining the relevant system indicators that will be acquired from users during their interactions with the MEMORISE system, and the higher-level features that will be inferred based on this information. In particular, we identify the indicators that the MEMORISE system will collect, divided into implicit measures, which are obtained automatically in the background, and explicit measures, which require the user's direct responses. Based on this information, we then also identify a series of higher-level features or user states that the system will infer, based on state-of-the-art techniques. We select all the aforementioned features based on

the final objective of providing an individualisation of the user experience to optimise the interaction with the system. Furthermore, we base these decisions on the technical constraints of the system to be implemented, while always preserving user privacy and always requiring the user's full informed consent for data collection, leaving this individualisation of the experience as an optional aspect of the system, to be decided by each user.

Content

Introduction

The latest advancements in virtual and augmented reality technology have created new avenues for experiencing historical heritage, offering innovative interaction paradigms, and enhancing the overall visitor experience. Among them, MEMORISE aims at developing a novel platform to process and exhibit a wide variety of Heritage content related to Nazi Persecution (HNP) using a variety of site-based, web-based, and mixed reality technologies. This technological platform facilitates the construction of understanding in the form of individualised audiovisual narratives through the active and embodied exploration of digitally enhanced physical sites implicated in the Holocaust and Nazi crimes.

More specifically, we will develop a suite of digital tools for presenting, narrating, and engaging with HNP data, including a web-based HNP platform for unguided exploration, an HNP reader to support comparative readings, as well as different on-site learning interfaces to support general public users in interacting with HNP in new ways.

At the heart of MEMORISE, there will be an infrastructure to assist consortia and associated memorial sites and archives in processing 80,000+ HNP content items to make them persistently accessible to the public across different modalities. With such a vast amount of content available to users, the need to individualise the experience increases. While some users might prefer a completely unguided exploration of the full content within our datasets, most users would benefit from an intelligent system that can offer content that is particularly relevant to the current individual, with different degrees of transparency. Therefore, the final MEMORISE system will include a framework to individualise the user experience.

The individual experience framework will start by collecting user feedback across different modalities. Then, this information will be processed, both online and offline, to estimate a series of relevant user states. These user states will be aggregated to create adaptive user models, considering the data collected and estimated. In addition to enriching the system's knowledge graph with this information, it will inform an artificial intelligence (AI) engine, which will deliver the individualisation of the experience to each user by providing different adaptations during the interaction, as well as suggesting different content to suit the interests of the user, thus acting like a recommendation engine.

This document focuses on the first steps of the individual experience framework: user state acquisition and estimation. Here, we will identify relevant system indicators that the system will collect from the interactions with users, as well as different high-level features that we will estimate from them.

User Feedback Acquisition

User Experience and Requirement Analysis

To address the challenges related to user interaction and engagement on the platform, we need to understand the users' needs and requirements. In the following sections, we describe user experience aspects such as interaction, evaluation, and analysis requirements proposing a series of user feedback indicators that will be used to analyse the user experience and eventually estimate user states.

Within MEMORISE, our research encompasses the examination of various factors, including the user's internal state (behaviour, expectations, needs, and motivation), as well as the characteristics of the designed system or platform (such as complexity, purpose, usability, and functionality). This comprehensive approach aids us in defining valuable features based on the user's knowledge, interests, goals, background, and individual traits. Moreover, it allows us to consider the context or environment in which the interaction takes place, including organisational and social settings, the meaningfulness of the activity, the voluntariness of use, and other potential adaptations of the system.

User experience (UX) enhances usability by analysing and informing decisions to improve the usability of the platform, resulting in smoother and more intuitive user experiences. In the field of cultural heritage, recent studies have pointed towards a change of direction and methods used to study the cultural spaces themselves within the user experience (Konstantakis et al., 2018).

The selection of a methodology for a UX research project should be determined by the research's scope and specific aspects, as well as the components to be evaluated. To achieve this, various evaluation methods can be employed. Formative evaluation involves the continuous collection of feedback and data throughout the project's development process, guiding its progression by pinpointing strengths, weaknesses, and areas of improvement. Front-end evaluation, on the other hand, takes place during the project's initial stages and aims to comprehend the target audience, their requirements, and preferences. This understanding contributes to the creation of suitable visualizations for the MEMORISE system.

In addition, we also consider the adaptive environment, which enhances interaction and personalization, enabling users to effectively utilize the platform and gain insights from the dataset based on their unique perspectives. Cultural Heritage guides and applications often struggle with the challenge of inundating users with an overwhelming volume of data, a phenomenon known as information overload. This issue has intensified with the widespread use of handheld tablet devices, characterized by limited resources such as small screens, low-capacity batteries, and platform interfaces. Simultaneously, the integration of new technologies, such as the Semantic Web, has expanded the pool of available data for users.

To address this, novel methods for data filtering have been proposed, with one of the most efficient approaches being the customization of information based on user profiles and interests. This ensures that users receive content that is not only accurate but also precise.

User Interaction with Digital Cultural Heritage Platforms

In the realm of digital cultural heritage, user interaction plays a pivotal role in facilitating meaningful connections between individuals and the rich tapestry of historical narratives, artefacts, and experiences. These digital platforms serve as gateways to the past, offering users the opportunity to explore, learn, and engage with diverse facets of cultural heritage. The design and implementation of these platforms go beyond conventional web interfaces, leveraging cutting-edge technologies to create immersive and interactive experiences.

One of the key considerations in designing digital cultural heritage platforms is the selection of content and how it is structured and represented. Curators and developers must carefully choose which historical sites, artefacts, or elements of heritage to include in these platforms. They must also determine the most effective way to present this content, whether through 3D and 4D visual explorations, audiovisual elements, or textual narratives. The goal is to strike a balance between preserving the historical authenticity of the content and making it accessible and engaging for users.

User engagement is at the forefront of digital cultural heritage platform design. Engaged users are more likely to return, explore, and achieve their goals within a digital application, resulting in better user satisfaction and potentially increased learning. To assess user engagement, a combination of quantitative metrics (e.g., click-through rates, time spent on a page) and qualitative methods (e.g., user surveys, interviews, and observations) is often employed. Additionally, tracking user attention, the perception of time, and task performance can provide valuable insights into engagement levels.

One of the prominent challenges in this domain is managing information overload. Digital cultural heritage platforms often house vast amounts of data, including historical documents, images, audio recordings, and more. The integration of new technologies, such as the Semantic Web, has expanded the pool of available data for users. To address information overload, platforms employ novel methods for data filtering and customization based on user profiles and interests. This ensures that users receive content that is not only accurate but also precise, enhancing their overall experience.

Spatially aware technologies, such as augmented reality (AR) applications, have transformed the way users interact with digital cultural heritage platforms, especially when visiting physical heritage sites or museums. AR apps bring historical narratives to life, superimposing digital information onto the physical environment. Users can explore geo-localized exhibits, access 3D and 4D reconstructions, and immerse themselves in the history of the site. This blend of physical and digital experiences adds a new layer of engagement, making heritage exploration more interactive and captivating.

Digital storytelling is another crucial aspect of user interaction with cultural heritage platforms. These platforms employ multimodal storytelling mechanisms to convey historical information through various communication modes, such as text, images, videos, and interactive elements. Enhanced interactivity is inherent in this approach, making the narratives more captivating and encouraging active user participation. By offering non-linear interaction and

opportunities for content contribution, digital cultural heritage platforms address the deficiencies of traditional heritage preservation methods.

Designing a user model based on user interaction involves understanding the characteristics and behaviour of the users who will be interacting with the MEMORISE system, framed within the digital cultural heritage context. This includes what is being modelled and how the information is structured or represented. It involves the selection of memorials, historical sites, or elements of the site that are being digitally recreated or simulated.

The platform will include functionality to support 3D and 4D visual content explorations with audiovisual and textual content. When engaging in pedagogical practices, be it historical or cultural learning, one cannot escape committing to a collection of explicit or implicit assumptions about the psychology of those involved. In the realm of holocaust studies and cultural learning, these assumptions typically take on an informal nature and are derived from common psychological notions that are prevalent in our day-to-day experiences (Verschure & Wierenga, 2022).

To provide users with meaningful and engaging interactions, and validate these, one approach is to conduct user research. This can involve surveys, interviews, and observation of users interacting with the platform through passive and active interaction, as well as automatic logging of this information. Following this approach, some memorial sites have developed and validated the approach in collaboration with a range of memorial sites and museums (Blancas et al., 2021). This approach helps us to analyse user experience in different physical sites and understand the needs, goals, and behaviour of our target audience.

In essence, user interaction with digital cultural heritage platforms is a dynamic and multidimensional process. It involves the careful curation of content, the use of immersive technologies, the measurement of user engagement, and the crafting of compelling narratives. These platforms bridge the gap between the past and the present, providing users with the means to explore and connect with cultural heritage in ways that were previously unimaginable.

Relevant System Indicators

In our user experience research project, it is crucial to gather a comprehensive set of indicators that accurately reflect the various states and behaviours of our users. These indicators provide valuable insights into how users interact with our platform and help us make informed decisions for improving the user experience. Having analysed the existing approaches, and considering the functionalities, requirements, and other characteristics of the MEMORISE system, we will outline the relevant system indicators to be acquired from user interactions.

These indicators can be broadly categorized into two main types depending on their data collection method: implicit indicators and explicit indicators. While explicit indicators rely on directly asking users for some information, implicit indicators are collected in the background without any direct input from users. Within the MEMORISE system, we will use a combination of both types of indicators to achieve an ideal balance between data richness and unobtrusiveness,

while always preserving the privacy of the users. In the following subsections, we detail those indicators.

Implicit Indicators

Implicit indicators are those data points that are automatically logged as users interact with our platform. They encompass a wide range of user behaviours and actions that are automatically tracked without requiring direct input from users. These indicators provide valuable insights into how users engage with the platform, whether accessed online via the website or through on-site touchscreen applications at memorial sites.

One critical aspect of implicit indicators is users' navigation patterns. This includes observing how users move through the platform, the sequence of pages or sections they visit, and whether they follow a linear or non-linear path. Analysing these patterns can help optimize the platform's information architecture and user flow, ensuring that users can access relevant content seamlessly.

The time users spend on specific pieces of content, such as articles, multimedia exhibits, or historical documents, is also a crucial implicit indicator. Longer dwell times may suggest deeper user engagement and interest in the subject matter, helping content curators understand what resonates most with visitors. Additionally, observing scroll behaviour reveals user reading habits and preferences. Researchers can gain insights into whether users quickly scroll through lengthy articles or engage in more in-depth reading by scrolling slowly and pausing at specific points.

Implicit indicators extend to user search behaviour as well. This includes analysing the frequency and types of searches users perform, shedding light on common user interests and informational needs. Such data can inform content curation and future updates.

For touchscreen applications at memorial sites, implicit indicators related to multimedia elements play a significant role. Researchers can track interactions with videos, images, audio clips, and 360-degree views to understand which multimedia assets resonate most with users and contribute to their immersive experience.

Monitoring error rates is another valuable implicit indicator, helping identify user struggles and errors, such as repeated attempts to access specific content or confusion in navigating the interface. These insights guide usability improvements.

Finally, implicit indicators may encompass how users interact with the specific device or technology. Observing touchscreen gestures, pinch-to-zoom actions, or changes in device orientation provides insights into how users manipulate the interface to access content and engage with the platform effectively. Collecting and analysing these implicit indicators offer a comprehensive understanding of user behaviour, preferences, and engagement levels. This information guides iterative improvements to the digital cultural heritage platform, ensuring it effectively educates and engages visitors while respecting the historical significance of Nazi

persecution.

Considering all this, the MEMORISE system will log the following implicit indicators:

- Visited content (metadata: category, keywords, etc.).
- Time spent interacting (total and per content).
- Amount of content interacted.
- Content exploration sequence.

Explicit Indicators

In addition to implicit indicators, we also employ explicit indicators to gain a deeper understanding of the user experience. Explicit indicators involve direct input from users, typically gathered through surveys, questionnaires, or feedback forms. These indicators provide valuable qualitative insights into users' perceptions, preferences, and emotions related to their interaction with the platform, both online and on-site at memorial sites.

One crucial aspect of explicit indicators is user feedback and opinions obtained through surveys and questionnaires. These instruments can be designed to solicit user sentiments, satisfaction levels, and subjective assessments of the platform's content and usability. Feedback can reveal user perceptions of the platform's effectiveness in delivering educational and commemorative experiences.

Explicit indicators also encompass users' self-reported experiences and emotions while interacting with the platform. Users may be asked to describe their emotional responses to specific content or exhibits, offering a deeper understanding of the platform's impact on visitors. This qualitative data can be instrumental in shaping content strategies and design decisions.

Additionally, explicit indicators can include user preferences and suggestions for improvement. Through open-ended questions, users can provide insights into what aspects of the platform they found most engaging, as well as areas where they believe enhancements or additional features are needed. These preferences can guide iterative development.

Surveys and questionnaires can also be tailored to gather demographic information, enabling researchers to gain insights into the diverse backgrounds of platform users. Understanding the demographics of the audience can help in tailoring content and experiences to better suit the needs and interests of specific user groups.

User interviews provide another avenue for collecting explicit indicators. In-depth interviews allow for in-depth exploration of users' experiences, motivations, and perspectives related to the

platform. Researchers can uncover valuable narratives and personal connections to the historical subject matter.

In summary, explicit indicators of interaction in the context of a digital cultural heritage platform dedicated to Nazi persecution involve direct input from users through surveys, questionnaires, interviews, and feedback mechanisms. These indicators provide qualitative insights into user perceptions, emotions, preferences, and demographics. By carefully analysing these explicit indicators, developers and curators can refine the platform's content and design to better serve the educational, commemorative, and emotional needs of visitors while ensuring historical sensitivity and respect.

Considering all this, the MEMORISE system will collect the following explicit indicators:

- Demographics and other personal aspects:
    - Age.
    - Gender.
    - Nationality.
    - Personal/Familiar involvement.
    - Group size.
- Subjective reports (questionnaires):
    - Enjoyment of interaction.
    - Usefulness of the experience.

It is important to highlight that users will always have the option to choose whether to provide this information or not. All questions are optional. The anonymity of the users will be preserved, without collecting any information that can be used to identify an individual (e.g., name, phone number, email).

The data relative to demographics and other personal aspects will be used to broadly categorise the users among a few different characteristic groups. This will be detailed in the deliverable D5.2: Adaptive user modelling based on static profiles and the first enriched Knowledge Graph version. The “Personal/Familiar involvement” aspect relates to visitors with second- or third-generation involvement in the in the camp. This might involve different groups of visitors, including Jewish, Sinti or Roma individuals, thus having an elevated level of personal relationship with the memorial site. This will be considered in order to deliver a personalised experience while always delivering it in an appropriate manner.

To collect subjective reports about the enjoyment of the interaction and the usability and usefulness of the system, we will employ an adaptation of the Intrinsic Motivation Inventory (IMI) (Ryan, 1982). In particular, we will use the scale Interest/Enjoyment and the scale Value/Usefulness. This scale has been adapted considering both the included guidelines and the contextual scenario in

order to maintain a respectful level of sensitivity toward the users, following the ethical guidelines detailed in deliverable D7.1: Ethics and Best-practice guidelines for virtual engagement with HNP.

Interest/Enjoyment:

- I enjoyed doing this activity very much.
- This interactive exploration was enjoyable to do.
- I thought this was a boring interactive exploration.
- This interactive exploration did not hold my attention at all.
- I would describe this interactive exploration as very interesting.
- I thought this interactive exploration was quite enjoyable.
- While I was doing this interactive exploration, I was thinking about how much I enjoyed it.

Value/Usefulness:

- I believe this interactive exploration could be of some value to me.
- I think that doing this interactive exploration is useful for learning.
- I think this is important to do because it can make me learn.
- I would be willing to do this again because it has some value to me.
- I think doing this interactive exploration could help me to better understand the events.
- I believe doing this interactive exploration could be beneficial to me.
- I think this is an important interactive exploration.

By combining both implicit and explicit indicators, we create a more comprehensive picture of the user experience, enabling us to make data-driven decisions and prioritize improvements that align with user needs and expectations.

User State Estimation

In this section, we cover the process of inferring the current state of a user during an interaction such as emotional state, cognitive load, physical state, and other relevant factors that can impact their interaction experience. Cultural user experience evaluation or user interaction measurement requires quantitative and qualitative approaches to gain a comprehensive understanding of user behaviour. It optimises the platform to provide a successful and informative user experience.

MEMORISE aims to preserve and enhance the historical information related to Nazi persecution by utilizing various forms of heritage such as diaries, letters, testimonies, death records, deportation statistics, and historical photographs. The project intends to create a comprehensive digital framework that virtualizes and links these multimodal HNP data resources. This framework will offer novel digital technologies to the general public for accessing, exploring, and engaging with HNP content.

Estimating user states within the context of a digital cultural heritage platform dedicated to Nazi persecution is a multifaceted process that draws insights from both implicit and explicit indicators of user interaction. These indicators collectively inform our understanding of how users engage with the platform and how they emotionally and cognitively process the historical content presented.

Implicit indicators, which, as discussed in the previous section, include data on navigation patterns, time spent on content, scroll behaviour, and device interaction, provide valuable behavioural cues. By analysing these implicit indicators, we can make educated estimations about the level of user engagement, the pathways users follow through the platform, and their preferences for specific content. For instance, prolonged engagement with survivor testimonies or multimedia exhibits may indicate a heightened emotional connection, while a pattern of rapid scrolling may suggest information skimming.

Explicit indicators, on the other hand, offer insights into the more subjective aspects of user states. Feedback obtained through surveys, questionnaires, and interviews provides a window into users' emotional responses, satisfaction levels, and overall impressions of the platform. Estimating user states based on explicit indicators involves assessing the reported emotions and sentiments expressed by users. Positive feedback, expressions of empathy or connection with historical narratives, and a sense of satisfaction indicate positive user states. Conversely, negative feedback or emotional distress may suggest negative user states that require attention and sensitivity in design and content presentation.

By combining implicit and explicit indicators, we create a more holistic understanding of user states. For example, if implicit indicators suggest users are spending extended time on a specific exhibit related to Holocaust survivor experiences and explicit indicators reveal that users report feeling moved or empathetic, we can infer that users are likely in a state of heightened emotional engagement and reflection.

Additionally, demographic information gathered through explicit indicators allows for a more nuanced estimation of user states. Understanding the background and characteristics of users, such

as age, cultural background, or prior knowledge of the subject matter, can help interpret their emotional responses and cognitive engagement. For instance, a survivor's family member may have a different emotional response than someone with no personal connection to the events.

In summary, estimating user states in the context of a digital cultural heritage platform on Nazi persecution involves a rich interplay between implicit and explicit indicators. Implicit indicators provide insights into user behaviour and engagement, while explicit indicators offer glimpses into emotional and cognitive states. The synthesis of these indicators empowers developers and curators to tailor the platform's content and design to elicit meaningful and respectful user experiences while honouring the historical significance of the subject matter.

Active Interaction Learning in Digital Heritage Environments

User interaction with digital cultural heritage platforms, especially those focused on sensitive historical topics like Nazi persecution, is a complex and sensitive area of study. Conducting user experience research in these digital systems is of utmost importance to ensure that the presentation and accessibility of such crucial information are effective, respectful, and emotionally considerate. This research aims to create platforms that educate, commemorate, and engage users while paying due respect to the historical gravity of the subject matter.

Digital cultural heritage platforms dedicated to Nazi persecution often serve multiple purposes, including education, remembrance, and research. The user interaction with these platforms can encompass a range of activities such as exploring archival documents, viewing multimedia exhibits, and reading survivor testimonies. Researchers must focus on creating an empathetic and user-centric experience that facilitates meaningful engagement.

To conduct user experience research in this context, various methodologies can be employed. Qualitative methods, such as in-depth interviews and focus groups, can be utilized to understand the emotional and educational needs of users interacting with these platforms. Surveys and questionnaires can help collect quantitative data on user preferences and satisfaction. Furthermore, eye-tracking technology can offer insights into how users navigate the interface and where their attention is focused, providing valuable feedback on the platform's design and content hierarchy.

One key aspect to consider is the ethical dimension of user research in digital cultural heritage platforms related to Nazi persecution. Researchers must prioritize the dignity and emotional well-being of users, many of whom may have personal or familial connections to the historical events. Implementing informed consent, providing appropriate content warnings, and offering resources for emotional support are essential components of ethical user research in this domain.

All things considered, conducting user experience research in digital cultural heritage platforms dedicated to Nazi persecution involves a multifaceted approach that integrates qualitative and quantitative methods. Ethical considerations are paramount, given the sensitive nature of the content and the potential emotional impact on users. By conducting thorough research and continuously refining the user experience, these platforms can effectively fulfil their

mission of educating and commemorating while respecting the historical significance of the subject matter.

Integrating all these factors, we will conclude the part by identifying the specific user states of relevance.

Relevant User States

Based on our exploration of implicit and explicit indicators in the previous discussions, here, we identify a series of relevant user states critical to our understanding of user interaction with the MEMORISE system. These user states, comprising attention, engagement, satisfaction/frustration, and emotional reaction, provide a comprehensive framework for evaluating and interpreting how visitors engage with the platform and emotionally respond to its historical content. In this subsection, we delve into each of these user states, offering insights into their significance within the context of our platform's educational and commemorative objectives, all while ensuring the utmost sensitivity and respect for the historical subject matter.

Attention

Attention refers to the cognitive process by which users selectively focus their awareness on specific elements within the digital cultural heritage platform. It involves the allocation of mental resources to engage with and process particular content or features. In the context of our platform dedicated to Nazi persecution, attention can be identified and measured through implicit indicators like navigation patterns and interaction heatmaps, which reveal where users are directing their focus. Explicit indicators, such as user feedback and survey responses, provide insights into the elements that initially capture the user's attention. Understanding attention is crucial for optimizing content and design to ensure that users engage meaningfully with the platform's educational and commemorative materials.

User Engagement

User engagement is the emotional, cognitive, and behavioural connection that exists, at any point in time and possibly over time, between a user and a physical space and Interactive technologies. Understanding user engagement is essential in designing effective and enjoyable digital experiences. Engaged users are more likely to return, explore, and achieve their goals within a digital application, resulting in better user satisfaction and potentially increased learning (Attfield et al., 2011).

Measuring user engagement is challenging due to its multidimensional nature. Researchers and designers often use a combination of quantitative metrics (e.g., click-through rates, time spent on a page) and qualitative methods (e.g., user surveys, interviews, and observations) to assess

engagement. Also, by focusing on user attention to the exclusion of other things by a distorted perception of time, follow-on task performance, and eye tracking (O'Brien & Toms, 2008).

The assessment of user engagement involves various objective indicators, including the subjective perception of time, subsequent task performance, and potentially physiological measures. These metrics are particularly well-suited for evaluating a limited number of closely spaced interaction instances. In contrast, the realm of web analytics has displayed a keen interest in quantifying user engagement using diverse methods aimed at gauging the depth of user interaction with a website.

Incorporating these considerations into the design and content of the AI web-based Heritage Platform will help cater to the diverse needs and interests of the different user groups while enhancing their overall experience at memorial sites involved in MEMORISE or informed by its outcomes. Conducting ongoing user research and collecting feedback will be crucial for refining the platform to meet the evolving needs of visitors.

Satisfaction/Frustration

Satisfaction and frustration represent two pivotal user states that reflect the overall quality of the user experience with the digital cultural heritage platform. Satisfaction signifies a positive user state, denoting contentment, fulfilment, and a sense of achievement in using the platform. Implicit indicators, like user engagement patterns and time spent on content, can indicate user satisfaction when users demonstrate prolonged interactions and exploration. Explicit indicators, such as survey responses expressing high levels of satisfaction, provide direct feedback on the user's positive experience.

Conversely, frustration embodies the inverse of satisfaction, signalling dissatisfaction, annoyance, or difficulty in navigating and utilizing the platform effectively. Implicit indicators may reveal frustration through user behaviours like rapid exits from certain sections or repetitive interaction patterns. Explicit indicators, like negative feedback in surveys or user comments highlighting difficulties in finding information, can pinpoint areas causing frustration.

Balancing satisfaction while minimizing frustration is critical in maintaining a positive user experience. This user state is integral to our platform's mission, as satisfaction fosters engagement and ensures that users can seamlessly access and emotionally connect with the historical content, ultimately achieving the platform's educational and commemorative goals.

Emotional Reaction

Emotional reaction is a profound and nuanced user state within the context of the digital cultural heritage platform dedicated to Nazi persecution. It encompasses the array of emotional responses

that users may experience when engaging with the platform's historical content, which can range from empathy, solemn reflection, and compassion to sorrow, anger, and even shock.

Implicit indicators may hint at emotional reactions through patterns of user interaction. For instance, users who spend extended periods on content related to survivor testimonies or explore multimedia exhibits in-depth may be experiencing heightened emotional engagement. Moreover, heatmaps and click-through rates can provide insights into which elements evoke stronger emotional reactions from users.

Explicit indicators, derived from user feedback, surveys, and interviews, offer valuable glimpses into these emotional responses. Users may describe their emotional reactions explicitly, such as feeling deeply moved by survivor narratives or emotionally affected by historical artefacts.

Understanding emotional reactions is pivotal in tailoring the platform's content and design to foster empathy, respect, and a meaningful connection with the historical subject matter. By acknowledging and respecting the diverse emotional states of users, the platform can effectively fulfil its mission to educate, commemorate, and engage, all while ensuring historical sensitivity and empathy for the gravity of Nazi persecution.

Conclusions

One of the objectives of the MEMORISE project, defined within work package 5 (WP5), is to be able to deliver an individualised experience to the user, based on their profile and interaction patterns. As such, one of the initial priorities in creating this individual experience framework lies in being able to collect all the necessary system indicators and then estimate a series of relevant user states. This involves logging information about each user's interactions with the system (e.g., which content they visit and for how long) and their profile (e.g., age and familiar involvement with the content). From this, for example, we could estimate the engagement of the user with the content, as well as suggest content that might be more relevant for that particular individual.

In this document, we have described in more detail the specific conceptual approach towards achieving this. This involves the MEMORISE system collecting both implicit and explicit indicators. Implicit indicators are automatically logged data points, including navigation patterns, content visited, time spent on each content and in total, scroll behaviour, and more. Explicit indicators involve direct user input through surveys, questionnaires, and feedback forms. Collecting and analysing these indicators enhances user understanding and guides iterative platform improvements, establishing a direct link with the objectives of work package 7 (WP7), Evaluation.

Based on these implicit and explicit indicators, we identified different relevant user states critical to user interaction that we will estimate to individualise the user experience: attention, engagement, satisfaction/frustration, and emotional reaction. Attention involves focusing on specific elements, engagement reflects the user's connection with the platform, satisfaction/frustration indicates the quality of the user experience, and emotional reaction encompasses a range of emotional responses to historical content. Understanding these states guides the platform's mission to educate, commemorate, and engage while respecting the gravity of Nazi persecution.

In future stages of the project, and of this work package in particular, we will continue to develop this framework. Specifically, we will start implementing the features described here to collect user feedback and estimate user states from this. Therefore, the technical details of such implementation will be incorporated to a revised version of this deliverable later in the project. Furthermore, we will use the outcomes of the module described in this document to develop adaptive user models, to be described in deliverable D5.2. Subsequently, we will use these models to deliver the individualisation of the user experience through the usage of a novel AI engine, to be described in deliverable D5.3. Finally, we will conduct a performance evaluation of the resulting framework, which will be reported in deliverable D5.4.

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