

Portraying Orang Ulu's Culture in Belaga, Sarawak Through Participatory Art (Interactive-Video Mapping-Sound Visualization)

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ABSTRACT

This study examines how *Orang Ulu* cultural heritage in Belaga, Sarawak, can be documented, interpreted, and re-presented through a participatory and practice-based immersive media framework. Adopting a qualitative design grounded in ethnographic inquiry and practice-based research, the study combined participant observation, audiovisual documentation, semi-structured interviews, thematic analysis, and creative translation across two phases of fieldwork. A total of 20 participants were involved in the fieldwork and consultation process, and 5 semi-structured interviews were conducted with selected participants. The findings identified four cultural domains as central to heritage representation in the study context: *tekna* oral storytelling, tattoo symbolism, *sape* music, and *ngajat* dance. These domains were not treated solely as cultural content, but as analytical and design-generative resources that informed the development of projection mapping, sound visualization, and the SiRi-ART mobile prototype. Qualitative observations across two exhibition sessions and informal stakeholder review suggest that immersive and mobile formats can support cultural accessibility, interpretive engagement, and intergenerational interest, although the evidence remains qualitative rather than statistically evaluative. The study contributes a culturally accountable workflow that links ethnographic documentation, thematic interpretation, participatory validation, and immersive media design. It further argues that the value of digital heritage initiatives depends not simply on technological innovation, but on sustained community involvement, interpretive clarity, and ethical representation.

KEYWORDS: *Orang Ulu* heritage, Participatory art, Interactive projection mapping, Sound visualization, Immersive storytelling

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1. INTRODUCTION

The *Orang Ulu*, particularly the Kayan and Kenyah communities in Belaga, Sarawak, face increasing pressure on the continuity of intangible cultural practices such as *tekna* oral storytelling, tattoo symbolism, *sape* music, and the *ngajat* dance. Recent scholarship on digital heritage suggests that indigenous cultural knowledge is increasingly vulnerable to discontinuity when intergenerational transmission weakens and when heritage practices are insufficiently documented in culturally appropriate ways. Shiri et al. (2021) argue that digital storytelling can support cultural heritage access and preservation when it is designed in ways that remain responsive to indigenous knowledge systems. Siliutina et al. (2024) likewise note that digital heritage

initiatives create new opportunities for preservation but also introduce challenges related to access, ethics, and cultural sensitivity. Within the Sarawak context, Lee et al. (2023) further show that storytelling-based digital approaches offer significant potential for communicating local cultural heritage to broader publics.

Although this context is frequently discussed in heritage discourse, the research problem is not simply cultural change itself. Rather, the scholarly challenge lies in how endangered practices can be documented, interpreted, and re-presented without reducing them to static archives or externalized cultural spectacle. Existing studies on indigenous digital heritage have demonstrated the promise of digital storytelling

and immersive media. Shiri et al. (2021) emphasize the value of participatory and culturally informed digital storytelling interfaces for indigenous heritage preservation. Herman (2025) further argues that mobile and digital heritage platforms can extend cultural experience beyond museums and institutional settings. Huang et al. (2025) also report that mobile applications can support younger generations' engagement with intangible cultural heritage through portable and self-directed learning environments. However, relatively few studies examine how ethnographic documentation, participatory art, and interactive installation can be integrated into a single design framework for *Orang Ulu* cultural representation in Belaga. This gap is both methodological and design-oriented because it concerns not only what is documented, but also how cultural knowledge is translated into forms of public engagement that remain accountable to community authority.

To address this gap, the study undertook two fieldwork phases, from 8 to 12 March 2023 and from 29 July to 2 August 2024, that combined ethnographic inquiry with participatory art practice. The first phase focused on documentation, relationship-building, and the identification of culturally significant motifs, sounds, and narratives. The second phase emphasized iterative interpretation, prototype development, and community consultation regarding the digital re-presentation of these materials. Guided by this structure, the study asks three questions:

- RQ1: Which *Orang Ulu* cultural elements were identified by participants as important for preservation and public representation?
- RQ2: How can ethnographic material be translated into projection mapping and sound-visualization design without displacing indigenous interpretive authority?
- RQ3: What forms of audience and stakeholder response emerge when these cultural narratives are presented through immersive media?

Participatory art provides the conceptual and methodological basis for this inquiry because it positions cultural representation as a collaborative process rather than a purely technical output. Bishop (2012) argues that participatory art redistributes representational authority by involving communities directly in the making and framing of cultural output. Pink (2020) further shows that ethnographic and visual methods can support context-sensitive interpretation when cultural meaning is embedded in lived practice and social relations. In this study, projection mapping and sound visualization were not treated as neutral display technologies. Instead, they functioned as design interfaces through which documented narratives, gestures, symbols, and sonic patterns were reinterpreted in consultation

with community participants. The methodological contribution of the study, therefore, lies in showing how ethnographic material can inform practice-based design decisions. The theoretical contribution lies in linking participatory art, digital storytelling, and immersive heritage representation within a co-creative framework centred on community agency.

Accordingly, the significance of presenting these narratives through interactive public installations should be assessed not as a normative claim of impact, but as a research proposition examined through qualitative observation and stakeholder feedback. Recent work in immersive and mobile heritage suggests that digital platforms can broaden access and support new forms of cultural engagement, but only when design, governance, and interpretation remain ethically grounded. Herman (2025) emphasizes that mobile heritage introduces new politics of access, circulation, and mediation. Siliutina et al. (2024) caution that technological innovation alone does not ensure cultural sustainability. For this reason, immersive presentation in the present study is treated as a means of exploring whether digitally mediated heritage can enhance accessibility, invite participation, and stimulate discussion across generations. The contribution is therefore not that interactive media automatically preserve culture, but that they offer a culturally accountable design strategy whose value depends on co-creation, contextual interpretation, and ongoing community validation.

2. LITERATURE REVIEW

The literature on indigenous digital heritage consistently shows that digital media can expand access to oral tradition and cultural memory. At the same time, it also warns that digitization can detach cultural materials from the authority structures that give them meaning. Shiri et al. (2021) argue that digital platforms can support preservation, transmission, and public visibility. Siliutina et al. (2024) similarly emphasize the opportunities that digital technologies create for cultural preservation. However, Manžuch (2017) highlights unresolved ethical concerns related to consent, ownership, and the governance of culturally sensitive knowledge. Smith (2012) further cautions that indigenous knowledge must remain under community authority if research and representation are to avoid reproducing extractive or colonial practices. For *Orang Ulu* representation, this tension is especially important because a digitally visible culture is not necessarily a culturally accountable one. The literature, therefore, suggests that preservation should be evaluated not only in terms of storage and display, but also in terms of interpretive control, relational ethics, and the capacity of digital form to remain answerable to community priorities.

Participatory art and digital storytelling become analytically relevant at precisely this point. Bishop (2012) argues that participatory art redistributes representational authority by involving communities directly in the making and framing of cultural output. Pink (2020) explains that digital storytelling offers a mechanism for translating lived memory into multimedia forms that can be shared more widely. Shiri et al. (2021) also show that digital storytelling can support cultural heritage access and preservation when it remains grounded in indigenous perspectives. However, these approaches are not interchangeable. Participatory art privileges process, negotiation, and shared agency, whereas digital storytelling often emphasizes mediation, circulation, and narrative form. In the context of indigenous heritage work, their productive intersection lies in the possibility of co-created digital representation. Stories are not merely captured for display but shaped through collaborative decisions about what may be shown, how it may be shown, and for whom.

On this basis, the manuscript adopts a conceptual framework that links five terms: participatory art, digital storytelling, projection mapping, sound visualization, and immersive media. Participatory art provides the governance logic of co-creation. Digital storytelling structures the translation of oral and performative knowledge into narrative media. Projection mapping and sound visualization operate as the specific design mechanisms through which cultural material becomes audiovisually legible. Immersive media describes the resulting mode of audience encounter. The value of this framework is that it explains the sequence by which cultural knowledge moves from ethnographic documentation to collaborative interpretation and then to interactive public representation, rather than treating these concepts as disconnected features of the project.

Projection mapping, otherwise known as video mapping, has grown into an important tool for articulating cultural narratives through the projection of images onto physical surfaces to create immersive encounters. Bimber and Raskar (2005) explain that projection mapping enables the merging of physical and virtual space, making it suitable for heritage and spatial storytelling contexts. Although originally developed in entertainment and advertising, the technology has increasingly been adapted for historical and cultural representation. The limitation in much of this literature, however, is that it tends to emphasize visual immersion and audience effect more than the cultural legitimacy of representational choices. In other words, projection mapping is often evaluated in terms of innovation, atmosphere, or engagement, while the question of who authorizes the imagery and narrative remains underdeveloped. For the present study, projection mapping is important not merely because it produces immersive surfaces, but because it provides

a spatial interface through which *Orang Ulu* visual motifs, movement forms, and narrative sequences can be recontextualized in collaboration with community participants.

Sound studies are relevant to this project not simply because *Orang Ulu* culture includes music, but because sonic form is central to how cultural meaning is experienced, remembered, and transmitted. Chion (2019) demonstrates that sound should not be treated as secondary to image because it shapes temporal perception, affective emphasis, and narrative interpretation. Blesser and Salter (2007) further show that sound configures spatial experience rather than merely accompanying it, a concept they describe as aural architecture. Applied to this study, these perspectives justify the use of sound visualization as a design method through which the rhythm, tonal contour, and affective texture of *tekna* recitation and *sape* performance can shape visual movement, pacing, and ambience within the installation. Their relevance, therefore, lies in explaining the translation mechanism between ethnographic sound data and audiovisual design decisions.

Recent research on immersive heritage technologies further indicates that public engagement depends not only on the novelty of the medium, but also on how carefully a project aligns technical form with cultural context. Pacetti-Donelson (2020) argues that mobile technologies can extend cultural engagement beyond fixed institutional settings. Herman (2025) similarly emphasizes that mobile heritage can reposition cultural content within everyday life rather than confining it to museums or archives. Huang et al. (2025) further show that mobile applications can support the transmission of intangible cultural heritage among younger generations. However, Siliutina et al. (2024) caution that these digital approaches also introduce practical constraints related to technological literacy, platform maintenance, and uneven access. The critical implication is that immersive heritage projects should not be evaluated solely in terms of spectacle or innovation. They must also be assessed in terms of sustainability, interpretive transparency, and the extent to which community participants retain meaningful influence over design and dissemination.

Taken together, the reviewed literature demonstrates three unresolved issues. First, indigenous digital heritage studies often discuss preservation and access but provide less detail on the design logic through which ethnographic material is converted into interactive media. Second, studies on immersive installations frequently emphasize audience experience without sufficiently grounding representational choices in community-led interpretation. Third, mobile heritage initiatives improve reach, yet the relationship between

site-based immersion and portable digital continuation remains underdeveloped. This study addresses these gaps by proposing and testing a participatory, practice-based workflow for representing *Orang Ulu* culture in Belaga through ethnographic documentation, immersive installation, and a mobile extension.

3. METHODOLOGY

This study adopts a qualitative methodology grounded in ethnographic inquiry and practice-based research to document, interpret, and re-present *Orang Ulu* cultural heritage in Belaga, Sarawak. Ethnography was employed to facilitate situated engagement with cultural practice, allowing the researcher to examine heritage not as abstract content, but as lived, performed, and socially embedded knowledge. This orientation is particularly appropriate for the study of intangible cultural heritage because it enables close attention to context, meaning, transmission, and community interpretation.

In parallel, the study is informed by a practice-based research framework in which creative production functions as a legitimate mode of inquiry rather than as a purely illustrative outcome. Candy and Edmonds (2018) explain that practice-based research in the creative arts generates new knowledge through the production of creative artefacts, provided that the making process is accompanied by critical reflection and methodological articulation. Likewise, Sullivan (2010) argues that art practice can operate as research when creative activity is treated as a systematic and reflexive process of investigation through which ideas are explored, tested, and communicated. In this study, these principles guided the development of projection mapping and sound visualization not merely as final outputs, but as research processes through which *Orang Ulu* cultural materials were interpreted, translated, and examined.

Accordingly, the methodology does not position artistic production as supplementary to the research. Instead, creative practice forms part of the analytical process itself. Ethnographic documentation generated the primary cultural material, including narratives, performances, visual motifs, and sonic elements. These materials were then interpreted through thematic and reflective analysis before being translated into immersive audiovisual forms. The resulting creative artefacts served both as research outputs and as interpretive instruments that enabled the study to investigate how cultural knowledge might be communicated through interactive media while remaining accountable to community meanings and protocols.

Participatory art provides the relational framework that connects ethnography and practice-based research in

this study. It ensures that the transformation of cultural material into immersive media is informed by community consultation, collaborative interpretation, and cultural protocol rather than by the researcher's aesthetic decisions alone. Through this framework, *Orang Ulu* participants were positioned not merely as research subjects but as contributors to the interpretive and creative process. This methodological integration is important because it supports a culturally accountable approach to heritage representation, in which documentation, analysis, and artistic translation remain grounded in community knowledge, participation, and review.

3.1 Research Design

This study employs a hybrid qualitative research design that integrates ethnographic inquiry, practice-based research, and participatory art. The design was developed to address two interconnected objectives: first, to document and interpret *Orang Ulu* cultural heritage within its lived social context; and second, to translate that cultural knowledge into immersive media forms through a collaborative and critically reflective process. Rather than treating ethnography and artistic production as separate activities, the study structures them as interdependent phases within a single research framework.

The design framework is organized into three sequential but interconnected phases. As shown in **Figure 1**, the research design progresses from ethnographic immersion and cultural documentation to interpretive analysis and thematic development, and finally to creative translation with participatory validation. The figure also illustrates the methodological relationship between ethnographic inquiry, practice-based research, and participatory art, while emphasizing the dialogic flow of inquiry from documentation to interpretation, then to creative practice and communal review. In this way, **Figure 1** functions not merely as an illustration, but as a visual summary of the methodological logic underpinning the study.

Phase 1 involved ethnographic immersion and cultural documentation. During this phase, the researcher engaged with the *Orang Ulu* community in Belaga through observation, interaction, and audiovisual recording to identify significant cultural practices, symbols, narratives, and performative elements. This phase established the primary cultural dataset and ensured that the study was grounded in the community context rather than an abstract representation. As indicated in **Figure 1**, this phase generated the foundational cultural material that informed all subsequent stages of analysis and creative development.

Phase 2 focused on interpretive analysis and thematic

development. Data generated through ethnographic engagement, including field observations, interviews, and audiovisual materials, were reviewed and interpreted to identify recurring cultural meanings, motifs, and expressive forms. This analytical stage functioned as the bridge between documentation and creative practice because it clarified which cultural elements were appropriate, meaningful, and relevant for translation into digital media. In this sense, analysis was not limited to textual interpretation, but also informed design thinking by identifying how narrative, movement, visual symbolism, and sound might be rearticulated in immersive form. **Figure 1** represents this phase as the central interpretive bridge between field documentation and creative translation.

Phase 3 involved creative translation and participatory validation. In this phase, the findings from ethnographic and thematic analysis were developed into projection mapping and sound visualization outputs through a practice-based process of experimentation, reflection, and revision. Participatory art principles were central at this stage because community members were not positioned merely as subjects of prior documentation,

but as contributors to the interpretation and shaping of the creative outputs. Feedback and consultation were used to review whether the resulting representations remained culturally intelligible, ethically appropriate, and consistent with community perspectives. As illustrated in **Figure 1**, this phase includes not only the production of creative outputs but also their refinement through communal review and validation.

This phased structure clarifies how art practice and ethnography were integrated throughout the study. Ethnography generated the contextual and cultural knowledge base; thematic interpretation translated that knowledge into analytical categories; and practice-based artistic development transformed those categories into immersive representations. Participatory art connected these stages by ensuring that the movement from documentation to design remained collaborative rather than extractive. Consequently, the research design advances a dialogic model of inquiry in which knowledge is generated not only through observation and analysis, but also through the iterative making and communal review of creative work.

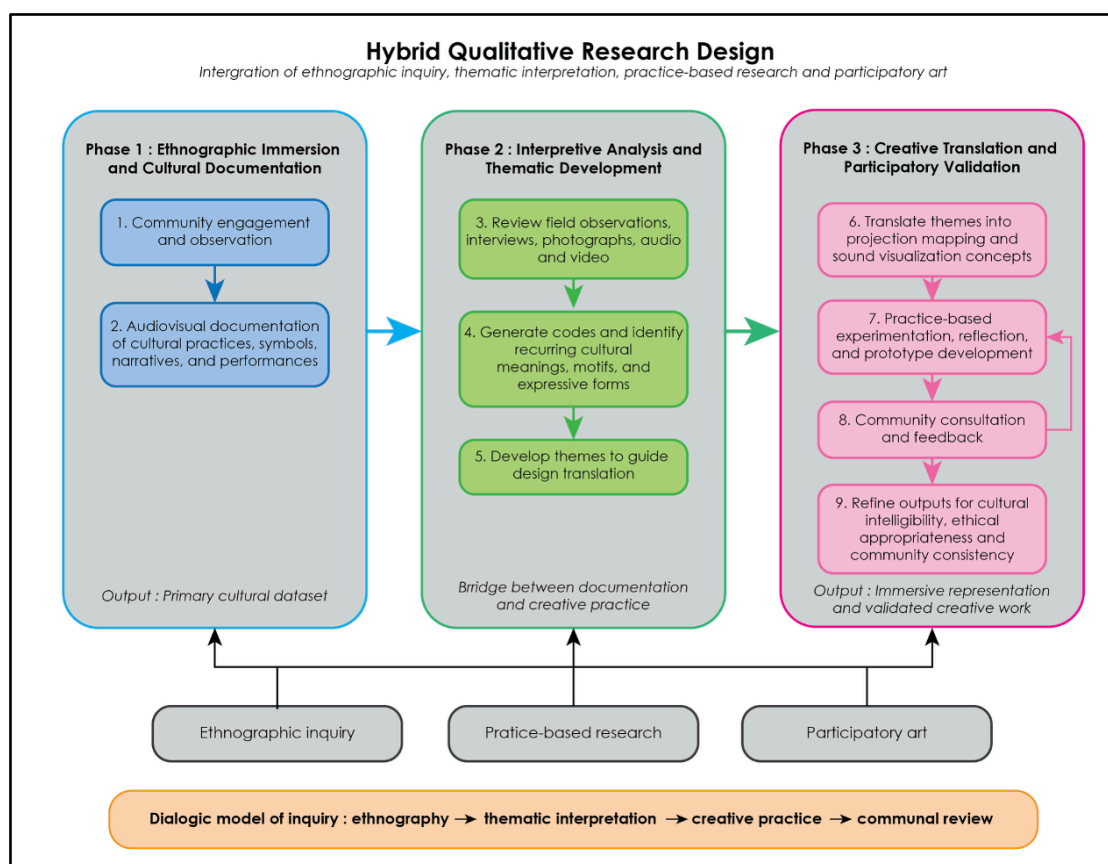


Figure 1: Hybrid qualitative research design illustrating the phased integration of ethnographic inquiry, thematic interpretation, practice-based research, and participatory validation in the present study

3.2 Research Site and Participants

Fieldwork was conducted in Uma Belun Leo Dian, Sungai Asap, Belaga, Sarawak (**Figure 2**), a settlement predominantly inhabited by the Kayan subgroup of the *Orang Ulu* community. The site was selected purposively because of its continued practice of *Orang Ulu* cultural traditions and the presence of community members with direct knowledge of oral storytelling, music, dance, tattoo symbolism, and related ceremonial practices.



Figure 2: Uma Belun Leo Dian, Sungai Asap, Belaga, Sarawak

Participants were recruited through purposive sampling based on their cultural knowledge, lived experience, and active involvement in traditional practices relevant to the study. The final participant group comprised 5 community elders, 9 cultural practitioners, 2 musicians, 3 dancers, and 1 village leader (*Penghulu*), resulting in a total of 20 participants. This sampling strategy was designed to ensure that the study engaged individuals who could provide informed perspectives on *tekna* oral storytelling, *sape* music, traditional tattooing, and the *ngajat* dance.

A total of 20 participants were involved in the fieldwork and consultation process, and 5 semi-structured interviews were conducted with selected participants across these categories. The inclusion of community elders and cultural practitioners was especially important because they served as key custodians of local knowledge, while musicians and dancers contributed practice-based insight into the sonic, performative, and embodied dimensions of *Orang Ulu* culture. The village leader (*Penghulu*) provided cultural and contextual guidance regarding community protocol, leadership approval, and interpretive legitimacy. In addition to the interviews, observation and consultation sessions were used to obtain further contextual understanding of cultural meaning, transmission, and representation.

Participation was voluntary, and informed consent was obtained from all participants prior to data collection. Ethical procedures emphasized transparency regarding the purpose of the study, the intended use of audiovisual documentation, and participants' right to withdraw at

any stage. These measures were essential to maintaining cultural sensitivity, supporting community trust, and reinforcing the study's commitment to decolonizing research practice and safeguarding indigenous interpretive authority.

3.3 Data Collection

Data collection was conducted during two fieldwork phases, namely from 8 to 12 March 2023 and from 29 July to 2 August 2024. The two phases were designed to support both cultural documentation and interpretive refinement. The first phase focused on initial ethnographic engagement, rapport building, and the documentation of key cultural practices. The second phase was conducted to deepen understanding, verify emerging interpretations, and gather additional material relevant to the creative translation of *Orang Ulu* heritage into immersive media. Multiple qualitative methods were employed to support triangulation and to generate a richer understanding of the cultural forms under study.

The primary data collection methods comprised participant observation, semi-structured interviews, and audiovisual documentation of cultural performances and daily practices. Participant observation was used to document the social and cultural contexts in which *Orang Ulu* heritage was expressed, with particular attention to performance setting, bodily gesture, spatial arrangement, participant interaction, and the symbolic meanings associated with specific practices. Observation was guided by a protocol that focused on four dimensions: (1) the form and sequence of cultural performance, (2) the visual and material elements involved, (3) the sonic and rhythmic characteristics of the event, and (4) the interaction between performers, community members, and the surrounding environment. This protocol enabled the researcher to document not only the content of cultural practices, but also the conditions through which they were performed, interpreted, and experienced.

Audiovisual documentation was carried out using digital video cameras, DSLR photography, and portable audio recording devices to capture performances, narratives, and environmental soundscapes. Video and audio recordings documented *tekna* (traditional oral storytelling), *ngajat* dance, *sape* music, and tattoo symbolism, while photography recorded material culture, traditional attire, body art, and ritual, as well as spatial environments. These audiovisual materials formed the primary ethnographic dataset and later served as the principal source material for the development of the projection mapping and sound visualization artworks. As shown in **Figure 3**, the data collection process involved direct engagement with participants in a natural community setting, supported by audiovisual recording equipment to document oral

narratives, cultural practices, and interactional contexts. The figure is important because it visually demonstrates the ethnographic setting of the fieldwork and the use of recording methods that supported the collection of rich qualitative data.



Figure 3: Data collection activities during ethnographic fieldwork, showing participant engagement, interview context, and audiovisual documentation in the community setting

A total of 5 semi-structured interviews were conducted with selected participants, particularly community leaders and cultural practitioners, to obtain contextual insights into the meanings, histories, and social significance of *Orang Ulu* cultural practices. The interviews were designed to explore four main areas: (1) participants' understanding of the cultural significance of *tekna*, *sape*, tattooing, and *ngajat*; (2) the ways these practices are transmitted across generations; (3) participants' views on the challenges of sustaining and representing these traditions today; and (4) their perspectives on appropriate forms of digital and artistic re-presentation. This interview structure ensured that the data addressed both heritage documentation and the ethical and interpretive considerations involved in translating cultural materials into immersive media.

To strengthen methodological transparency further, the manuscript should also report the approximate duration of each interview or the average interview length, for example, by stating whether interviews lasted between 30 and 60 minutes. Including this detail would clarify the depth of engagement achieved through the interview process and address reviewer expectations more fully.

3.4 Data Analysis and Creative Development

Data analysis employed thematic analysis following the six-phase framework proposed by Braun and Clarke (2006). In this study, thematic analysis was used not only to identify recurring patterns within the qualitative dataset but also to establish an explicit analytical bridge between ethnographic documentation and the subsequent development of immersive digital outputs. The dataset consisted of interview transcripts, observation notes, video recordings, audio recordings, and photographic documentation collected during

the two fieldwork phases. Analysis proceeded iteratively, moving between textual interpretation, audiovisual review, and reflective memoing to identify culturally significant patterns relevant to both heritage interpretation and creative translation. As shown in **Figure 4**, the analytical process moved from ethnographic data collection to thematic interpretation, creative translation, participatory validation, and ongoing reflection. The figure is important because it visually clarifies how coded data and emergent themes informed the subsequent development of immersive media outputs, rather than functioning as a separate or purely illustrative stage of the research.

3.4.1 Familiarization with Data

The first phase involved repeated reading, viewing, and listening across the full dataset. Interview transcripts, field notes, observational records, video documentation, and audio recordings were reviewed multiple times to establish familiarity with the material and to identify recurring references to cultural meaning, symbolic forms, performance structure, and representational concerns. During this phase, reflexive notes and analytic memos were maintained to capture preliminary observations, emerging patterns, and contextual nuances. Attention was given to how participants described the significance of *tekna*, *sape*, tattoo symbolism, and *ngajat*, as well as how these practices were observed in performative and spatial contexts.

3.4.2 Generating Initial Codes

The second phase involved the generation of initial codes across the dataset. Coding was conducted manually by assigning descriptive and interpretive labels to meaningful segments of text, sound, image, and observed action. To strengthen analytic transparency, the coding scheme was organized into four broad domains. The first domain, cultural practices and symbols, included tattoo symbolism, ceremonial attire, body ornamentation, and material artefacts. The second domain, narrative and oral transmission, included *tekna* as a storytelling practice, memory transmission, ancestral knowledge, and intergenerational continuity. The third domain, performative and sonic elements, included dance movement, gesture, rhythm, tempo, vocal tone, and *sape* musical sequences. The fourth domain, representational and ethical concerns, included community authority, authenticity, consent, symbolic accuracy, and acceptable modes of digital representation. Examples of initial codes included "tattoo as an identity marker," "*tekna* as cultural memory," "*sape* rhythm as sonic motif," "*ngajat* as embodied heritage," and "community concern for cultural accuracy." These codes enabled the analysis to move beyond descriptive documentation toward a more structured interpretation of how *Orang Ulu* cultural material might be translated into immersive media.

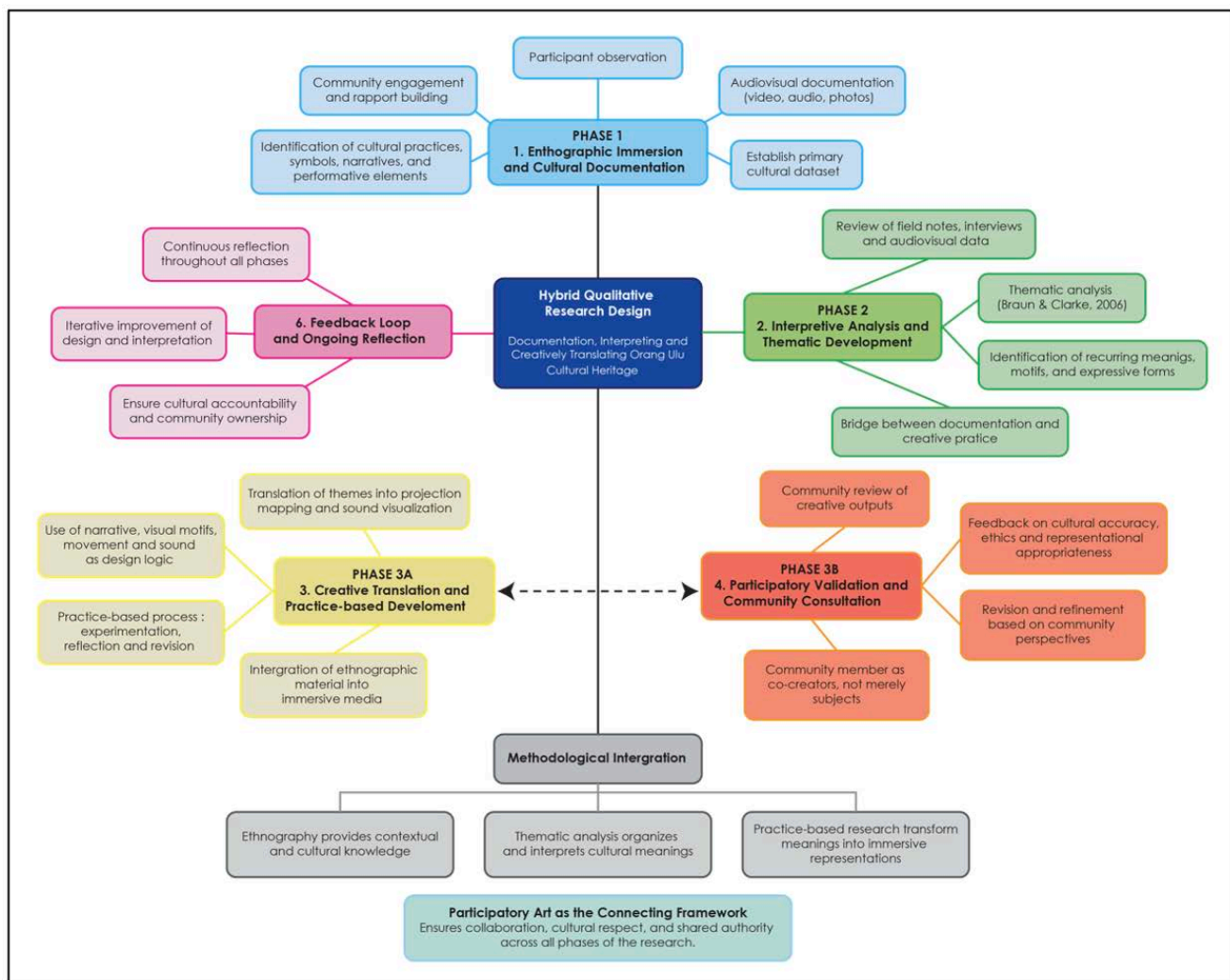


Figure 4: Thematic analysis and creative development framework showing the relationship between ethnographic data, key themes, creative translation, participatory validation, and ongoing reflection

3.4.3 Searching for Themes

In the third phase, coded segments were compared across interviews, observation notes, and audiovisual documentation to identify candidate themes. Theme generation was based on three criteria: recurrence across more than one data source, conceptual similarity between codes, and direct relevance to the research questions. For example, codes relating to tattoos, visual motifs, and social identity were grouped into the candidate theme, symbolic inscription and identity. Codes concerning storytelling, memory, and oral transmission were grouped under oral continuity and cultural memory. Codes relating to rhythm, gesture, dance, and sound were grouped into embodied and sonic heritage. Meanwhile, codes concerning consent, authority, and interpretive legitimacy were grouped into cultural accountability in digital representation.

To make the theme generation process clearer, the analysis treated themes not as pre-existing categories,

but as interpretive patterns that emerged through repeated comparison of coded material. In other words, themes were generated through a process of clustering related codes and testing whether these clusters were sufficiently coherent, meaningful, and analytically useful.

3.4.4 Reviewing Themes

In the fourth phase, candidate themes were reviewed against both the coded extracts and the full dataset. This stage was necessary to ensure that each theme was internally coherent, adequately supported by the data, and sufficiently distinct from the others. Discrepant cases were examined to refine thematic boundaries and prevent overgeneralization. For instance, not all references to cultural performance were treated as identical; some were more strongly associated with memory and oral continuity, whereas others contributed more directly to embodied movement or sonic responsiveness. This iterative comparison helped

refine the final thematic structure and strengthened the interpretive credibility of the analysis.

3.4.5 Defining and Naming Themes

The fifth phase involved defining and naming each theme in a way that captured both its cultural significance and its relevance to the study's analytical and creative objectives. Four themes were retained as central to the study. The first, symbolic inscription and identity, referred to tattoos, attire, and visual motifs associated with identity, status, and cultural marking. The second, oral continuity and cultural memory, referred to *tekna* and other forms of transmitted narrative knowledge. The third, embodied and sonic heritage, referred to dance, gesture, musical rhythm, vocal cadence, and performative expression. The fourth, cultural accountability in digital representation, referred to community authority, authenticity, consultation, and ethical representation. These themes were selected because they were consistently supported across different forms of data and because they provided a clear analytical basis for the translation of ethnographic material into immersive media design.

3.4.6 Producing the Report

The sixth phase involved integrating the thematic findings into the written analytical account and linking them explicitly to the creative development process. Rather than treating thematic analysis as an end, the findings were used to inform both the discussion and the design logic of the projection mapping and sound visualization works. In this sense, the report does not merely summarize themes; it demonstrates how thematic interpretation shaped the representational strategy of the project.

Table 1 presents representative coded excerpts and observations together with their corresponding initial codes, final themes, and design implications. The table is included to make the analytical pathway from raw qualitative data to immersive media translation more

transparent.

In qualitative thematic analysis of this kind, coding reliability was established through analytic transparency, repeated re-reading, cross-checking across multiple forms of data, and reflective memoing rather than through statistical inter-coder agreement. Because the study adopts an interpretive qualitative approach, reliability is understood in terms of consistency, coherence, and traceability of the analytic process. The repeated comparison of interviews, observation notes, and audiovisual materials functioned as a form of internal triangulation, helping to ensure that the retained themes were grounded in more than a single data source.

3.4.7 Creative Development Process

The thematic findings informed the creative development pipeline, which translated ethnographic data into immersive audiovisual outputs through four interconnected stages. The first stage involved ethnographic documentation, in which cultural practices, narratives, sounds, gestures, and visual motifs were recorded through observation, interviews, photography, video, and audio recording. The second stage involved thematic interpretation, during which the documented material was coded and grouped into themes that clarified which cultural elements were significant, how they functioned within *Orang Ulu* heritage, and which representational sensitivities needed to be respected. The third stage involved design translation, in which the themes were converted into visual, sonic, spatial, and temporal design parameters. This stage functioned as the key translation mechanism between ethnographic data and immersive output. The fourth stage involved prototype review and community validation, in which preliminary outputs were reviewed and refined in consultation with community participants to ensure cultural intelligibility, symbolic accuracy, and ethical representation.

Table 1: Representative coded excerpts, themes, and design implications

Representative excerpt or observation	Initial code	Theme	Design implication
"The stories must come from us; technology should not change their meaning."	Community authority over representation	Cultural accountability in digital representation	Community consultation used to validate narrative content and symbolic accuracy
"When <i>tekna</i> is performed, it carries memory from older generations to younger ones."	<i>Tekna</i> as intergenerational memory	Oral continuity and cultural memory	Narrative pacing and sequencing informed projection structure
Repeated observation of tattoo motifs associated with identity and status	Tattoo as an identity marker	Symbolic inscription and identity	Tattoo patterns translated into projected graphic forms and texture layers
Rhythmic <i>sape</i> sequences shaped the emotional flow of the performance	<i>Sape</i> rhythm as sonic motif	Embodied and sonic heritage	Musical rhythm informed animation tempo and sound-responsive behaviour

To make the design pipeline more explicit, the creative development process followed a clear translation logic. Tattoo symbolism was translated into visual design through projected line work, repetitive pattern structures, and layered graphic textures. Ceremonial attire and ornamentation informed colour palette, texture density, and visual emphasis within projection compositions. *Tekna* recitation informed narrative pacing and sequencing, with its cadence and narrative progression shaping the timing, transitions, and unfolding structure of projection scenes. *Sape* rhythm and tonal contour informed animation tempo and sound-responsive movement, with musical rhythm, tempo, and tonal variation translated into animation speed, amplitude-responsive movement, and visual intensity. *Ngajat* gesture and movement informed motion trajectories and spatial composition, with bodily posture, gesture, and directional movement shaping the motion logic and spatial arrangement of projected forms.

3.5 Ethical Considerations

Ethical integrity constituted a foundational principle of the study, informing design, data collection, analysis, and dissemination. Prior to fieldwork, permission was obtained through community leadership, and participants were informed about the purpose of the research, the recording process, and the possible public presentation of selected materials. Consent procedures involved verbal explanation in context-sensitive terms and written or recorded agreement, where appropriate to the setting and participant preference. Because cultural materials varied in sensitivity, permission was treated as an ongoing process rather than a single form-based event, with participants able to clarify limits on recording, reproduction, and exhibition during subsequent consultation.

Care was exercised in documenting sacred or culturally sensitive elements to prevent misrepresentation, commodification, or appropriation. Audiovisual materials, including video recordings, photographs, and sound files, were stored in encrypted formats and utilized exclusively for research and agreed-upon dissemination purposes. Access to these materials was restricted to the research team, and all outputs underwent collaborative review with community representatives prior to exhibition or publication.

This ethical framework is consistent with decolonizing research methodologies, which advocate for indigenous agency, cultural sovereignty, and shared authority in knowledge production (Smith, 2012). As Smith contends, research is not a neutral enterprise; historically, it has been deeply implicated in colonial power structures, often positioning indigenous peoples as objects rather than as knowledge holders. Decolonizing research necessitates a paradigmatic shift centering Indigenous

worldviews, privileging local epistemologies, and fostering reciprocal relationships wherein communities exercise authority over research processes (Smith, 2012). By positioning the community as an active collaborator rather than a passive subject, this study reinforced principles of relational accountability and participatory governance. Iterative consultations ensured that creative interpretations such as projection mapping and sound visualization adhered to cultural protocols and respected symbolic meanings. Through these measures, the research sought not only to minimize harm but to cultivate trust, reciprocity, and enduring partnerships that contribute to cultural sustainability.

4. RESULTS AND DISCUSSION

4.1 Cultural Documentation Findings

Fieldwork in Belaga, Sarawak, identified four cultural domains that were consistently emphasized by participants as central to *Orang Ulu* heritage in the study context: *tekna* oral storytelling, traditional tattooing, *sape* music, and *ngajat* dance. Rather than treating these as a general inventory of cultural practices, the analysis examined why these domains were prioritized by participants and how each contributed differently to the study's practice-based design process. In analytical terms, the findings show that each domain offered a distinct representational affordance: *tekna* contributed narrative structure and vocal cadence; tattooing provided symbolic and graphic motifs; *sape* supplied sonic and rhythmic material; and *ngajat* offered embodied movement and spatial performance. The significance of these findings, therefore, lies not only in documenting endangered heritage but in demonstrating how specific cultural forms could be interpreted and translated into immersive media.

Traditional tattooing, referred to as *tatu* in Kayan and *betiek* in Kenyah (Table 2), emerged in the dataset as more than a historical marker of social hierarchy. Participants described tattoo motifs as culturally meaningful signs associated with identity, status, and inherited value. From an analytical perspective, this was important because tattooing presented one of the clearest pathways from ethnographic documentation to visual design translation. The patterned geometry, repetition, and symbolic density of tattoo motifs made them suitable for adaptation into projected line structures, layered textures, and animated surface compositions. Thus, the finding is not simply that tattooing once carried social meaning, but that its symbolic visual logic made it especially relevant to the visual language of the projection mapping process. In this sense, Barthes' notion of signification and Bourdieu's concept of symbolic capital provide interpretive support for understanding tattoo motifs as both cultural markers and design resources (Barthes, 1977; Bourdieu, 1986).

The *ngajat* dance was documented not only as a performative tradition associated with martial valour and communal expression, but also as an embodied source of movement logic (Table 2). Observations of gesture, bodily posture, costume, and spatial positioning revealed that *ngajat* contributed more than thematic content; it informed how motion could be structured within the immersive installation. This means that *ngajat* functioned analytically as a movement-based model through which the design of projected motion, sequencing, and spatial rhythm could be developed. Rather than merely representing the dance as cultural content, the study used its performative structure to guide visual pacing and directional movement within the projection environment. This interpretive move establishes a clearer analytical link between ethnographic observation and creative output, while also supporting Schechner's view of performance as a vehicle of collective memory and identity (Schechner, 2003).

The oral tradition of *tekna* emerged as a major narrative resource because participants consistently described it as a vehicle of memory, instruction, and cultural continuity (Table 2). Its importance within the findings lies in both content and form. On the one hand, *tekna* provided narrative material rooted in cosmology, history, and social knowledge. On the other hand, its cadence, tonal variation, and sequencing contributed formal qualities that informed the temporal structure of the immersive work. The distinction between *tekna asen* and *tekna maring* further suggests that Orang Ulu storytelling is not fixed, but adaptive, capable of accommodating continuity and transformation simultaneously. Analytically, this matters because the study is not concerned with static archival preservation alone, but with how heritage can be re-presented in contemporary media without severing its relation to cultural meaning. In this way, the findings support UNESCO's view of oral tradition as living intangible heritage while also demonstrating its relevance to narrative pacing and sequencing within immersive storytelling design (UNESCO, 2003).

The *sape* was identified as both a cultural symbol and a practical source of sound-based design input (Table 2). Participants and observations indicated that its role extends across ceremonial, social, and affective contexts. For the purposes of this study, however, its significance was not limited to symbolic identity. The *sape* also supplied measurable sonic qualities, including rhythm, tonal contour, tempo, and mood, that informed the sound-responsive behaviour of the installation. This interpretation is consistent with Kartomi's (1990) discussion of musical instruments as both aesthetic forms and culturally functional artefacts. The analytical value of this finding, therefore, lies in showing how ethnographically sound data became a direct design

parameter, rather than functioning only as cultural background.

Taken together, these findings demonstrate that the four cultural domains were not only thematically important but methodologically generative. Each domain informed a different aspect of the immersive design pipeline. Tattoo motifs informed projected graphic patterns and texture layers; *tekna* informed narrative sequencing and vocal pacing; *sape* recordings shaped sound-responsive timing and visual intensity; and *ngajat* informed movement trajectories and spatial composition. Stating the findings in this way clarifies the analytical link that was previously underdeveloped. The contribution of this subsection is therefore not simply to describe *Orang Ulu* cultural practices, but to show how ethnographic findings were transformed into specific design logics within the projection mapping and sound visualization process.

Table 3 summarizes the relationship between the four principal cultural findings, their analytical meaning, and their corresponding design translation within the immersive system. This table is important because it makes explicit how ethnographic findings informed projection mapping and sound visualization decisions.

Table 3: Relationship between cultural findings, analytical meaning, and design translation

Cultural finding	Analytical meaning	Design translation
Tattoo motifs	Identity, status, symbolic inscription	Graphic pattern and texture generation
Tekna storytelling	Memory, continuity, narrative structure	Projection sequencing and temporal pacing
Sape music	Rhythm, tonal contour, affective atmosphere	Audio-reactive animation and visual intensity
Ngajat dance	Embodied heritage, movement, spatial rhythm	Motion paths and spatial composition

This relationship between documentation and design also strengthens the broader argument of the study. The findings indicate that immersive media can become culturally meaningful only when the representational system is grounded in the formal and symbolic properties of the cultural material itself. In the present study, ethnographic interpretation did not end with thematic description; it functioned as the basis for creative translation. Consequently, the cultural documentation findings should be understood not as background information for the installation, but as the analytical foundation through which the visual, sonic, and spatial logic of the immersive outputs was developed.

Table 2 documents the principal *Orang Ulu* cultural practices and material culture observed during fieldwork. The table functions as visual and descriptive

evidence of the ethnographic material that informed the analytical and creative phases of the study.

Table 2: Documented Orang Ulu cultural practices and material culture

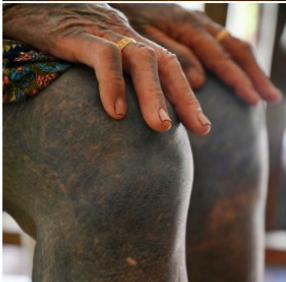
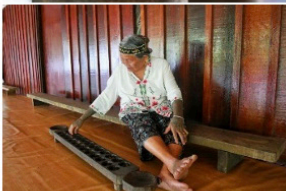
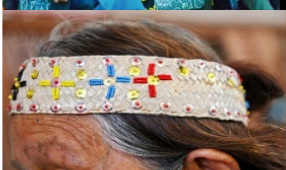
Subject	Description
	Ngajat -traditional Orang Ulu dance
	Orang Ulu traditional tattoos
	Orang Ulu woman playing congkak
	Orang Ulu man playing sape
	Orang Ulu man playing sape
	Orang Ulu woman wearing indigenous corona headband
	Orang Ulu woman wearing an indigenous corona headband

Table 2 (continued): Documented Orang Ulu cultural practices and material culture

Subject	Description
	Orang Ulu long-eared woman
	Orang Ulu women wear their traditional attire
	Orang Ulu woman smokes a jakok kayan
	Orang Ulu woman wrapping a tobacco leaf of jakok kayan
	Salong - a traditional Orang Ulu's burial house
	Old folks at Uma Belun Leo Dian
	Members of the Orang Ulu community performing tekna

4.2 Audience Engagement Through Immersive Public Installations

The public deployment of projection mapping and sound visualization suggested that immersive presentation could attract attention and stimulate audience interaction in exhibition contexts. However, this finding should be interpreted cautiously because the present study did not collect standardized visitor counts, formal interaction metrics, or instrument-based behavioural measurements. Instead, this subsection is based on qualitative observational evidence gathered across two exhibition sessions, supplemented by informal audience response and stakeholder feedback. The contribution of this section, therefore, lies not in

statistically proving audience impact but in describing the forms of engagement observed when *Orang Ulu* cultural narratives were presented through immersive media.

Observational data were generated through on-site viewing of audience behaviour during the public presentation of the installation. Observation focused on three dimensions: (1) audience attention and duration of viewing, (2) bodily movement and physical response to projected and sound-responsive elements, and (3) spontaneous verbal or social reactions to the content and technology. Field notes were written during observation where feasible and expanded immediately after each exhibition session to preserve contextual detail and reduce recall loss. Where audience members made spontaneous comments during the viewing experience, these comments were documented in the field notes as informal qualitative observations rather than as structured interview data. These observations were recorded as qualitative field impressions rather than quantified metrics. For this reason, the section should be read as an interpretive account of audience response rather than a formal evaluation study.

Within these limits, the observational evidence indicated that the immersive audiovisual environment generated visible forms of curiosity, movement, and discussion among viewers. Interactive features, including motion-triggered projection effects and sound-responsive visual change, appeared to encourage viewers to shift from passive watching to more active forms of engagement, such as moving closer to the projection surface, adjusting their bodily position in response to the visuals, and verbally reacting to changes in the audiovisual display. Younger viewers appeared especially responsive to these interactive elements, although this should be understood as a qualitative tendency observed *in situ* rather than as a measured demographic conclusion. Accordingly, the findings suggest that immersive presentation can alter the mode through which audiences encounter cultural material, even if the present study does not claim quantified evidence of engagement intensity.

From an interpretive perspective, these observations are consistent with theories of presence and embodied interaction. Lombard and Ditton (1997) describe presence as the perceptual illusion that mediated experience is felt as immediate or natural, while Dourish (2001) emphasizes that interaction is shaped through bodily engagement with mediated environments. Kolb's (1984) experiential learning framework is also relevant because active sensory participation can deepen engagement by allowing audiences to encounter cultural material through direct and memorable experience. In the present study, these concepts help explain why the installation appeared to hold audience

attention beyond conventional static display formats.

The installation also functioned as an interpretive interface, translating *Orang Ulu* intangible heritage into a multisensory public encounter. By combining visual motifs, narrative sequencing, movement-based projection, and sound-responsive elements, the work enabled audiences to engage with cultural material in a form that was more spatially and sensorially immediate than conventional documentary display. This suggests that immersive media may support accessibility and interpretive engagement, particularly where heritage is unfamiliar to wider audiences. Nevertheless, these claims should remain proportional to the evidence presented. Without visitor counts, interaction logs, or comparative audience measures, the present subsection should be understood as offering a qualitative account of observed engagement patterns, not a formal assessment of impact or effectiveness.

For this reason, the main value of the installation in analytical terms lies in demonstrating that immersive heritage presentation can generate observable audience attention, bodily response, and interpretive discussion within public exhibition settings. Future research would strengthen this line of inquiry by incorporating visitor counts, interaction tracking, structured observation sheets, and post-experience audience interviews or surveys to evaluate engagement more systematically.

4.3 Projection Mapping Outcomes and Development of Siri-Art

The projection mapping component of the SiRi-ART initiative translated *Orang Ulu* cultural narratives into an immersive audiovisual installation through a system that integrated ethnographic media assets, digital animation, sound-responsive processing, and large-scale projection output. The installation was developed not simply as a visual display, but as a practice-based media system in which recorded cultural materials were reorganized into responsive spatial compositions. In this sense, the projection mapping outcome should be understood as both a creative artefact and a research prototype that tested how *Orang Ulu* oral, visual, and performative heritage could be re-presented within a digitally mediated environment.

From a technical perspective, the system architecture comprised four main components: (1) media input, (2) content processing, (3) real-time audiovisual control, and (4) projection output. The media input layer consisted of ethnographic source material collected during fieldwork, including video recordings of *tekna* performance, *sape* music, movement references derived from *ngajat* dance, and still images of tattoo motifs and ceremonial attire. These materials were prepared as digital assets for the projection environment and organized

according to thematic and visual relevance.

The content processing stage involved the preparation and editing of visual and audio assets using Adobe After Effects, Adobe Premiere Pro, and TouchDesigner. At this stage, visual motifs were isolated, stylized, and sequenced into projection-ready compositions, while audio materials were edited to preserve rhythmic and tonal characteristics relevant to the *Orang Ulu* cultural forms being represented. Tattoo motifs were translated into graphic patterns and layered textures, *tekna* sequences informed the narrative structure of scene transitions, and *sape* recordings provided the sonic basis for responsive visual modulation. This step was essential because it established the design pipeline through which ethnographic documentation was transformed into structured media content.

The third stage of development focused on real-time audiovisual control, whereby incoming sound signals directly influenced the behaviour of projected visuals. The interactive system was structured so that selected audio parameters, including rhythmic pulse, amplitude, and tonal variation, were continuously analysed and mapped to corresponding visual attributes such as animation tempo, scale, brightness, and movement intensity. This sound-reactive environment enabled the projection output to respond dynamically to sonic characteristics derived from *Orang Ulu* performance traditions, thereby reinforcing the relationship between indigenous cultural source material and immersive visual representation. The interactive framework was implemented using TouchDesigner, while real-time audio feature extraction and trigger mapping were facilitated through the Essentia CHOP Suite plugin.

The final stage consisted of projection output and spatial installation. The processed visuals were projected onto the façade of the Sarawak State Museum using a high-brightness WUXGA laser projector with an output of 7,000–10,000 ANSI lumens. The projection surface functioned as an immersive interface through which animated motifs, narrative structures, and sound-responsive movement became visible at a public scale. The installation design was spatially arranged to encourage embodied viewing, allowing audiences to experience *Orang Ulu* cultural materials through movement, attention, and sensory immersion rather than through static observation alone.

Conceptually, the system architecture supported a clear translation mechanism between ethnographic findings and design output. Tattoo symbolism informed graphic pattern generation and surface texture. *Tekna* recitation informed narrative pacing, temporal sequencing, and the unfolding structure of projected scenes. *Sape* rhythm and tonal contour informed audio-reactive visual behaviour, particularly animation tempo and

intensity. *Ngajat* movement references informed motion trajectories and spatial composition within the projected environment. By clarifying the projection system in these terms, the study demonstrates that the installation was not based on arbitrary aesthetic treatment, but on an analytically grounded design workflow derived from field-based cultural documentation.

The projection mapping installation should therefore be understood as a practice-based research prototype rather than as a fully engineered commercial system. Its significance lies in testing how *Orang Ulu* cultural narratives could be translated into an immersive media form that remained responsive to sound, movement, and symbolic detail. While the system successfully demonstrated a working model of cultural translation through projection mapping, future iterations would benefit from fuller technical reporting, including software versioning, signal flow diagrams, projector specifications, and interaction logging. Including these details in the final manuscript would strengthen the paper's contribution to new media research by making the installation more reproducible and methodologically transparent.

Observationally, the installation suggested that the projection environment could sustain audience attention and prompt bodily response, particularly when sound-reactive changes were perceptible in real time. However, these observations remain qualitative and interpretive rather than metric-based. The value of this subsection, therefore, lies in demonstrating the technical and conceptual feasibility of the projection mapping system as a culturally grounded immersive interface, rather than in claiming formal performance evaluation.

Table 4 presents the interactive video mapping storyboard used in the projection mapping installation. The table summarizes the main projected scenes and clarifies how *Orang Ulu* cultural motifs, narrative sequencing, and sound-responsive visualization were structured in the final audiovisual output.

4.4 Development of Siri-Art

Building on the projection mapping outcomes, the project progressed toward the development of SiRi-ART, an interactive mobile application intended to extend access to *Orang Ulu* cultural content beyond the temporal and spatial limits of site-specific installation. In analytical terms, the application was conceived not merely as an additional dissemination platform, but as a mobile prototype that tested whether the cultural materials translated into immersive public display could also be adapted into a more personal, portable, and repeatable form of engagement.

Table 4: Interactive video mapping storyboard

Scene	Description
	Interactive video mapping projection with sound visualization on the facade of a public space/building in portraying the unique culture and identity of the Orang Ulu ethnic an introductory scene
	Interactive video mapping projection scene 2
	Interactive video mapping projection scene 3
	Interactive video mapping projection final scene

The development method followed a practice-based and iterative design process. Cultural materials derived from the ethnographic phase, including curated visual motifs, selected audio recordings, narrative content, and interpretive media assets, were reorganized into a mobile interface structure. This process involved three stages: (1) content selection and curation, (2) interface and navigation design, and (3) prototype refinement. As shown in **Figure 5**, the application begins with QR-code access, webpage redirection, application launch, and menu-based navigation to specific *Orang Ulu* cultural content. **Figure 5** is important because it illustrates the overall navigation structure of the SiRi-ART prototype and demonstrates how users move from initial access to the selection of cultural themes such as the Kayan community, *sape*, *ngajat*, *tekna*, and general knowledge of *Orang Ulu* heritage.

From a research perspective, the significance of SiRi-ART lies in how it extends the logic of the projection mapping installation into a mobile environment. Pacetti-Donelson (2020) emphasizes user-directed access and mobile implementation in cultural settings. Herman (2025) argues that mobile heritage can extend cultural engagement beyond institutional spaces. Huang et al. (2025) further show that mobile applications can support continuity of engagement and heritage transmission among younger users. In the present study, the mobile prototype was designed not only to store cultural information, but also to provide an interactive

point of entry into an immersive heritage experience.

Figure 6 further illustrates the AR interaction flow within the SiRi-ART prototype. Specifically, it shows how users select the immersive AR feature, activate the experience through image-based triggering, and then proceed through a sequence of cultural content segments, including *Orang Ulu* identity, *sape*, *ngajat*, and *tekna*. This figure is significant because it clarifies how the application moves beyond static information delivery and functions instead as a structured immersive interface that connects mobile interaction with sequential cultural storytelling.

To provide an initial level of evaluative feedback, the prototype was informally reviewed by 21 selected participants and stakeholders for content clarity, cultural appropriateness, and navigational logic. The review group comprised 1 Community Chief (*Penghulu*), 5 Cultural Practitioners/Elders, 2 Academics, 5 Students/Youth, 3 Corporate Representatives, and 5 members of the General Public. This informal review did not constitute a full usability study using standardized instruments or controlled testing procedures. However, it provided preliminary insight into whether the prototype was understandable to users, culturally appropriate in its presentation, and navigable across different stakeholder groups.

The findings from this informal review support a cautious interpretation of the prototype's value. Feedback from the review process suggested that the application was generally understandable in structure and conceptually aligned with the broader goals of cultural dissemination and accessibility. At the same time, because the review was informal and did not employ structured usability metrics such as task-completion rates, time-on-task, or interface satisfaction scales, the present manuscript does not claim validated usability effectiveness in a technical sense.

Even so, the development of SiRi-ART remains significant within the context of the study. It demonstrates how ethnographic documentation and immersive design can be extended into mobile form through a curated and practice-based process. Smith (2012) is especially relevant here because decolonizing methodologies require that indigenous communities remain involved in shaping how their knowledge is represented, circulated, and interpreted through digital platforms.

4.5 Stakeholder and Audience Feedback

The stakeholder and audience feedback analysis indicates that responses to the project were broadly supportive but not uniform across groups. Instead, the coded dataset revealed different evaluative priorities depending on participants' cultural roles, professional backgrounds, and anticipated relationship to the

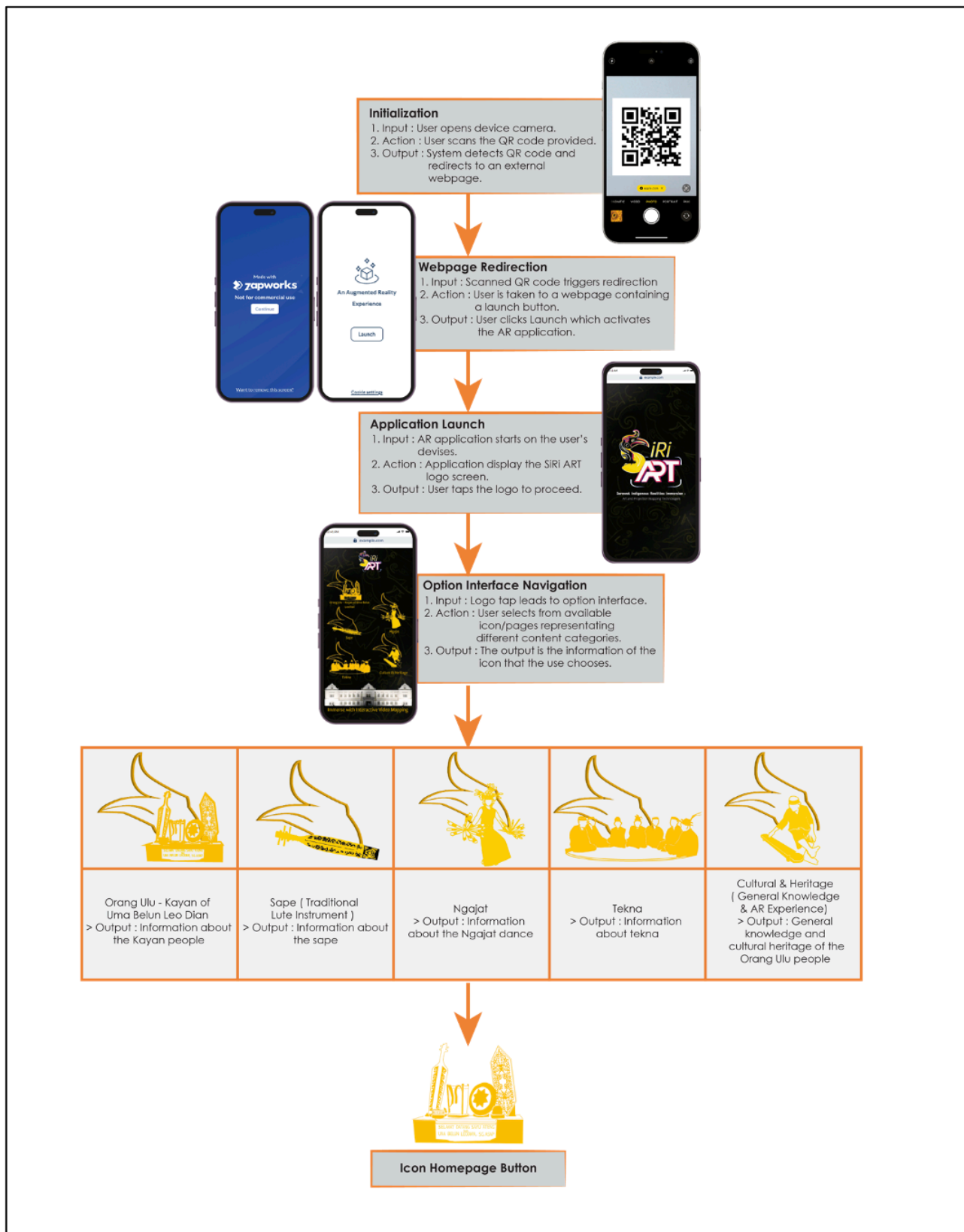


Figure 5: Navigation flow of the SiRi-ART mobile prototype from QR access to cultural content selection

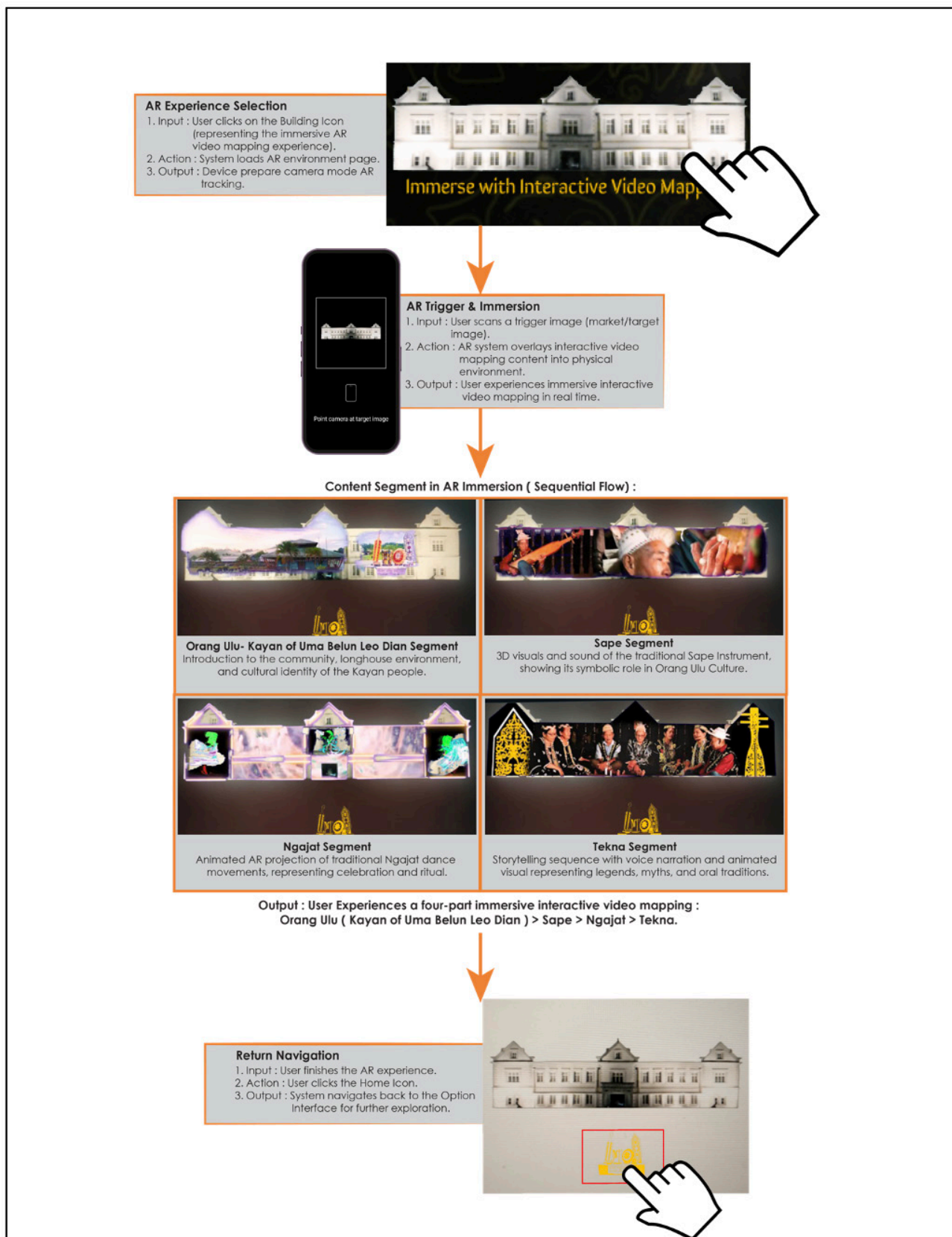


Figure 6: Augmented reality interaction flow and immersive content sequence in the SiRi-ART application

project. As shown in **Table 5**, community leaders and cultural practitioners most consistently emphasized cultural authenticity and intergenerational transmission, reflecting their concern that digital representation should preserve meaning rather than merely increase visibility. This finding is significant because it suggests that, for community-based stakeholders, the value of immersive media depends less on technical novelty than on whether symbolic forms, stories, and performative elements remain under culturally informed interpretation.

By contrast, academics and educators more frequently highlighted the educational value and research contribution of the project. Their responses indicate that immersive storytelling was understood not only as a creative form of presentation but also as a pedagogical and documentary resource capable of making cultural knowledge more accessible, engaging, and experientially meaningful. Students, youth participants, and members of the public responded more strongly to technological engagement, often describing the projection mapping and mobile prototype as more memorable, interactive, and approachable than static or text-based forms of cultural presentation.

Table 5: Thematic distribution of stakeholder feedback by group, with representative evidence

Respondent	Stakeholder Group	Dominant Themes Identified	Representative Excerpt / Evidence	Indicative Frequency
	Community Chief (Penghulu)	Cultural authenticity; intergenerational transmission; sustainability	"The stories must come from us; technology should not change their meaning."	High
	Cultural Practitioners / Elders	Cultural authenticity; intergenerational transmission	Emphasized that symbols, sounds, and narratives should remain faithful to Orang Ulu meanings and be passed to younger generations.	High
	Academics	Educational value; sustainability; research contribution	Described the project as "a living archive that students can experience rather than only read about."	Moderate
	Students / Youth	Technological engagement; intergenerational transmission	Reported that the interactive format made the culture feel more engaging, memorable, and easier to understand.	High
	Corporate Representatives	Sustainability; economic and creative potential	Highlighted possible value for cultural tourism, exhibition development, and socially responsible creative initiatives.	Moderate
	General Public	Technological engagement	Informal responses indicated that the projection and app were visually engaging and attracted curiosity.	Moderate

This pattern suggests that immersive media may be especially effective in attracting attention and stimulating cultural curiosity among audiences who are more accustomed to digital modes of interaction.

Corporate representatives, meanwhile, placed greater emphasis on sustainability, scalability, and economic or creative potential. Their feedback framed the project in relation to future development, cultural tourism, exhibition expansion, and broader creative-industry application. However, this perspective did not operate independently of the others. Across the dataset, support for the project remained conditional upon cultural accountability, ethical management, and meaningful community involvement. In this respect, the stakeholder feedback does not simply demonstrate approval of immersive heritage technologies; rather, it shows that different stakeholder groups valued the project for different reasons, while converging on the view that digital heritage initiatives must remain culturally grounded and responsibly developed.

As further synthesized in **Table 6**, these interpretations collectively reinforce the study’s broader argument that immersive and mobile heritage platforms can support cultural preservation only when technical innovation is matched by community participation, interpretive clarity, and long-term sustainability. The feedback, therefore, extends the findings beyond description by showing how the project was received, evaluated, and conditionally endorsed across multiple stakeholder groups. This makes the stakeholder analysis an important part of the study, not simply as supplementary opinion, but as qualitative evidence of how participatory immersive heritage practice is interpreted by those most closely connected to its cultural, educational, and public dimensions.

As shown in **Table 5**, stakeholder groups did not interpret the project uniformly. Community leaders and cultural practitioners placed the strongest emphasis on cultural authenticity and intergenerational transmission, whereas academics foregrounded educational and research value. Students, youth participants, and members of the public responded more directly to technological engagement, while corporate representatives highlighted sustainability and economic or creative potential. The inclusion of representative excerpts and relative prevalence indicators clarifies how these interpretations emerged from the coded dataset rather than from summary impressions alone.

Table 6 provides a condensed analytical summary of stakeholder interpretations, their supporting qualitative evidence, and their implications for cultural preservation and digital storytelling practice. Unlike a purely descriptive summary, this table links interpretive claims to representative responses and indicates their relative prominence within the dataset.

Table 6 indicates that stakeholder interpretations converged around the value of immersive and mobile media, but for different reasons. Community members and elders primarily emphasized authenticity and cultural authority, whereas academics focused on educational and archival value. Youth participants and general audiences responded more strongly to interactivity and memorability, while corporate representatives highlighted sustainability and creative-sector potential. Presenting the table in this form makes clear that these conclusions were derived from coded qualitative evidence rather than from a summary impression alone.

Table 6: Summary of stakeholder interpretations, supporting evidence, and implications

Stakeholder Category	Key Interpretation	Representative Evidence	Relative Prevalence	Implication for Cultural Preservation
Community & Elders	Digital media can support cultural revitalization only if authenticity and community control are maintained	Emphasized that stories, symbols, and sounds should remain faithful to Orang Ulu meanings and be guided by community authority	Strong	Supports community-led heritage preservation and culturally accountable representation
Academics & Educators	Immersive storytelling has educational and research value because it makes cultural knowledge more accessible and experiential	Described the project as functioning like a "living archive" that can be experienced rather than only read about	Strong	Positions immersive media as a pedagogical and documentation tool
Youth & General Public	An interactive and multimedia presentation increases attention, curiosity, and memorability	Reported that the projection and app were engaging, easier to follow, and more memorable than static forms of presentation	Moderate to strong	Increases cultural awareness and accessibility among wider audiences, especially younger users
Corporate & Industry	The project has potential for sustainability, outreach, and creative-sector development if managed ethically	Highlighted possible relevance to cultural tourism, exhibition programming, and socially responsible creative initiatives	Moderate	Suggests pathways for scalable and sustainable heritage models

4.6 Discussion

This discussion is structured in relation to the study's three research questions. The first question asked which *Orang Ulu* cultural elements were identified by participants as important for preservation and public representation. The findings indicate that *tekna* oral storytelling, tattoo symbolism, *sape* music, and *ngajat* dance were consistently prioritized because each carried a distinct cultural function and offered a different form of representational potential within the project. Importantly, these elements were not selected only because they are recognizable cultural markers, but because participants and field observations showed that they contained narrative, visual, sonic, and performative features that could be translated into immersive media. In this respect, the study extends previous work on indigenous digital heritage by showing more explicitly how specific cultural forms can function as design resources rather than merely as documentary content. Shiri et al. (2021) argue that digital storytelling can support heritage access and preservation. The present findings support that view, but they also show that access alone is insufficient unless cultural material is interpreted through a structured and participatory design process.

The second research question asked how ethnographic material could be translated into projection mapping and sound visualization without displacing indigenous interpretive authority. The findings suggest that this translation is most defensible when it follows a participatory workflow in which documentation, coding, thematic interpretation, and design translation remain connected to community consultation. This point is significant because many discussions of immersive heritage emphasize technological innovation or audience experience without explaining how ethnographic material becomes media output. In contrast, the present study demonstrated a more explicit translation logic: tattoo motifs informed graphic patterning; *tekna* informed narrative pacing; *sape* informed sound-responsive behaviour; and *ngajat* informed motion trajectories and spatial composition. This contributes to the literature by making the analytical pathway from field documentation to creative output more transparent. Candy and Edmonds (2018) are relevant here because practice-based research requires that creative work function as a form of knowledge production rather than as a decorative outcome. Sullivan (2010) likewise supports the view that artistic practice can serve as a systematic and reflexive mode of inquiry. The findings in this study are consistent with those frameworks because the immersive outputs emerged through iterative interpretation and consultation rather than through aesthetic improvisation alone.

The third research question concerned the forms of audience and stakeholder response that emerged

when *Orang Ulu* cultural narratives were presented through immersive media. The findings suggest that the projection mapping installation and the SiRi-ART prototype generated positive interest, curiosity, and interpretive engagement across stakeholder groups, but the evidence should be interpreted cautiously because it remains qualitative rather than statistically evaluative. The study did not collect visitor counts, formal interaction metrics, or standardized usability measures. Accordingly, the discussion does not claim empirical proof of effectiveness in a quantitative sense. Instead, the qualitative observations and stakeholder feedback suggest that different groups valued the project for different reasons. Community leaders and cultural practitioners emphasized authenticity and interpretive control. Academics highlighted the educational and research value. Students, youth participants, and members of the public responded more directly to interactivity and memorability. Corporate representatives emphasized sustainability and creative potential. These patterns suggest that immersive heritage initiatives are interpreted through multiple stakeholder lenses rather than through a single measure of success.

These findings can be compared with prior studies in several ways. First, the project supports arguments in the digital heritage literature that immersive and mobile media can broaden access to cultural content beyond conventional archival or exhibition formats. Pacetti-Donelson (2020) emphasizes the value of mobile technologies in extending cultural engagement beyond fixed heritage institutions. Herman (2025) similarly argues that mobile heritage can relocate cultural experience into everyday contexts. Huang et al. (2025) further show that mobile applications may support younger users' engagement with intangible cultural heritage. The current findings are consistent with these studies, particularly in showing that a mobile extension such as SiRi-ART can complement site-based immersion by allowing continued and individualized access. However, the present study also complicates this optimistic view by showing that portability and accessibility do not automatically resolve questions of cultural governance, usability, or long-term sustainability.

Second, the findings support but also refine prior discussions of participatory and decolonizing approaches to heritage representation. Smith (2012) argues that indigenous communities should retain authority over how their knowledge is interpreted and circulated. The present study aligns with that position because community consultation functioned not merely as an ethical procedure, but as part of the methodological structure through which design choices were validated. At the same time, the findings show that participatory involvement is not a simple guarantee of authenticity. It requires ongoing review, negotiation,

and sensitivity to symbolic meaning. In this sense, the study contributes to prior scholarship by showing that cultural accountability must be embedded not only in research ethics but also in the design workflow of immersive media practice.

Third, the audience-response findings resonate with but do not fully verify theoretical claims about presence, embodiment, and participatory spectatorship. Lombard and Ditton (1997) argue that mediated environments can generate a sense of presence, while Dourish (2001) emphasizes the embodied character of interaction. Bishop (2012) discusses how participatory art can alter the role of the audience from passive observer to active participant. The present findings are broadly consistent with these perspectives because audience members were observed moving in response to the projected environment, reacting to sound-responsive visuals, and engaging with the work in a more active manner than a static display would typically invite. However, because the study did not measure presence or behavioural engagement quantitatively, these frameworks are used here as interpretive lenses rather than as empirically confirmed outcomes. This distinction is important for maintaining methodological accuracy.

The discussion also reveals several limitations that define the scope of the study's contribution. First, the participant and stakeholder data remain qualitative and relatively small in scale, which limits generalization beyond the specific study context. Second, the projection mapping system and mobile prototype were examined primarily as practice-based research outputs rather than as fully evaluated technical systems. Third, although the study demonstrates a viable design workflow, it does not yet provide formal usability testing, long-term audience tracking, or comparative evaluation across multiple sites. These limitations do not invalidate the findings, but they do indicate that the study should be understood as a qualitative and practice-based contribution rather than as a comprehensive evaluative model.

Overall, the study contributes to current debates in digital heritage, participatory art, and practice-based research by showing how ethnographic documentation, thematic analysis, and immersive media design can be integrated within a culturally accountable framework. Its main contribution lies not in claiming that immersive technology inherently preserves heritage, but in demonstrating the conditions under which immersive and mobile media can support heritage representation in a way that remains analytically grounded and community responsive. Future research should therefore build on this foundation by incorporating structured usability testing, clearer technical reporting, multilingual implementation, and longitudinal evaluation of how immersive heritage experiences shape cultural learning, memory, and identity over time.

5. CONCLUSION

This study examined how *Orang Ulu* cultural heritage in Belaga, Sarawak, can be documented, interpreted, and re-presented through a participatory and practice-based immersive media framework. The findings indicate that *tekna* oral storytelling, tattoo symbolism, *sape* music, and *ngajat* dance were identified as the most significant cultural domains within the study context because each offered distinct narrative, visual, sonic, and performative qualities. Rather than functioning solely as cultural content for display, these forms operated as the analytical basis for the design of projection mapping, sound visualization, and the SiRI-ART mobile prototype.

A central contribution of the study lies in demonstrating how ethnographic documentation, thematic analysis, and creative translation can be linked through a structured and culturally accountable workflow. The findings suggest that immersive media may provide a meaningful mode of cultural representation when design decisions remain grounded in community consultation and cultural interpretation. The study also shows that projection mapping and mobile heritage can function as complementary rather than separate formats, with one supporting collective spatial engagement and the other extending access through portable, repeatable interaction.

At the same time, the findings must be interpreted within the limits of the evidence presented. The study was based on a qualitative and practice-based design involving 20 participants, 5 semi-structured interviews, observational evidence across two exhibition sessions, and an informal review of the mobile prototype by 21 selected stakeholders. It did not include formal visitor counts, quantified interaction metrics, controlled usability testing, or long-term evaluative measures. For this reason, the article does not claim statistical proof of effectiveness but instead offers a qualitative account of how immersive and mobile media can be developed and interpreted as culturally grounded forms of heritage representation.

Overall, the study suggests that immersive heritage practice is most defensible when technology is not treated as neutral or inherently beneficial, but as a medium whose value depends on how it is designed, interpreted, and governed. The implications of the study lie in its contribution to culturally accountable heritage design, participatory research practice, and immersive media development. Future research should build on this foundation by incorporating clearer technical reporting, structured usability testing, multilingual interface development, and longitudinal evaluation of audience learning and cultural engagement.

ARTIFICIAL INTELLIGENCE (AI) USE AND DISCLOSURE

The authors declare that no artificial intelligence (AI) tools were used in the preparation of this manuscript.

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