Digital Revival: Virtual Access to Hidden Cultural Heritage - Al Ain Aflaj Discoveries, UAE

Malak Al Ajou [1]*, Peter Sheehan [1]

[1] Dept. of Culture and Tourism, Al Ain, UAE – (Majou, Peter.sheeha)@dctabudhabi.ae

Keywords: Digital Archaeology, Aflaj, Augmented Reality, Heritage Platform, Cultural Heritage Management.

Abstract

Over the past five years, extensive archaeological excavations conducted by our dedicated team in Al Ain, United Arab Emirates, a UNESCO World Heritage-listed city, have revealed more than 60 Aflaj (ancient underground water channels) at over 150 sites, spanning periods from the Iron Age to the Late Islamic era. These discoveries significantly enhance our understanding of ancient water management systems and their essential role in agricultural sustainability and historical development of the region over the last three thousand years.

This paper introduces the "Aflaj Discoveries" digital platform, developed by the Historic Environment Department of Abu Dhabi's Department of Culture and Tourism, to activate its role in protecting and preserving cultural heritage while sharing it with a global audience. Our team employed advanced digital documentation methods, including terrestrial 3D laser scanning and close-range photogrammetry, to meticulously record these historically valuable subterranean water systems. Through interactive maps, detailed 3D visualisations, and immersive augmented and virtual reality (AR/VR) experiences, the platform provides unprecedented virtual access to cultural heritage sites that are currently inaccessible or hidden, enabling users to explore these sites interactively without physical barriers.

While creating significant opportunities for public engagement, the development of the Aflaj Discoveries platform faced challenges related to sustainability, management of digital assets, intellectual property rights, and data security. Practical insights from similar UAE-based initiatives, such as Sharjah's Historical Map, Umm Al Quwain's Archaeological Digital Platform, and the Dive into Heritage platform, are explored to illustrate shared challenges and innovative solutions within this evolving domain.

Ultimately, this paper offers theoretical reflections and practical recommendations for developing inclusive, accessible, and sustainable digital heritage platforms. It advocates an approach that balances technological innovation, ethical considerations, and practical sustainability, contributing effectively to heritage preservation and dissemination to future generations.

1. Introduction

Despite significant advancements in cultural heritage documentation, many archaeological discoveries remain physically out of reach for the public—either preserved below ground or removed following professional assessment. This challenge is particularly present in rapidly developing urban contexts such as Al Ain, where discoveries often emerge unexpectedly during infrastructure projects rather than through planned excavations. Over the past few years, the Department of Culture and Tourism – Abu Dhabi (DCT) has identified and documented more than 150 archaeological Aflaj sites across the city, leading to the recognition of over 60 separate Aflaj . These water systems are not just functional remains—they are the deep infrastructure of Al Ain’s cultural identity, silently sustaining its landscape for millennia. While each discovery receives careful documentation and mitigation measures designed to preserve as much as possible in situ—the gap between expert access and public engagement remains significant, raising broader questions about visibility, cultural ownership, and the role of heritage in everyday urban life.

In response to these persistent challenges, the Historic Environment Department (HED) at the Department of Culture and Tourism (DCT) – Abu Dhabi developed the Aflaj Discoveries platform as a direct solution to enhance public access to otherwise hidden heritage. Designed to visualize underground and restricted sites, the platform integrates interactive 3D models, georeferenced maps, contextual media, and site narratives to create an accessible and engaging digital experience. Rather than simply showcasing archaeological data, the platform repositions discoveries within the lived and built environment of Al Ain, offering a more human and spatially-aware mode of heritage interpretation. While still in its early phase and not yet officially launched, the platform reflects an emerging shift in cultural policy—from preservation for experts, to open cultural engagement and shared responsibility.

2. Context and Methods

2.1 Global Heritage Expectations vs. Local Realities

This tension becomes even more pronounced when viewed through the lens of global heritage expectations. The inscription of Al Ain on the UNESCO World Heritage List in 2011 placed the city within a global framework of heritage responsibility. Recognized for its ancient Falaj systems, archaeological landscapes, and cultural continuity, the city’s inclusion underscores the international expectation to protect, interpret, and make accessible its tangible and intangible heritage. The Falaj, in particular, represents not only a hydraulic solution, but a symbol of collective resilience and continuity in one of the world’s most arid inhabited regions. It enabled the rise of oasis-based agriculture, making long-term human settlement and social organization possible in otherwise inhospitable terrain. However, these ideals often collide with local realities. In Al

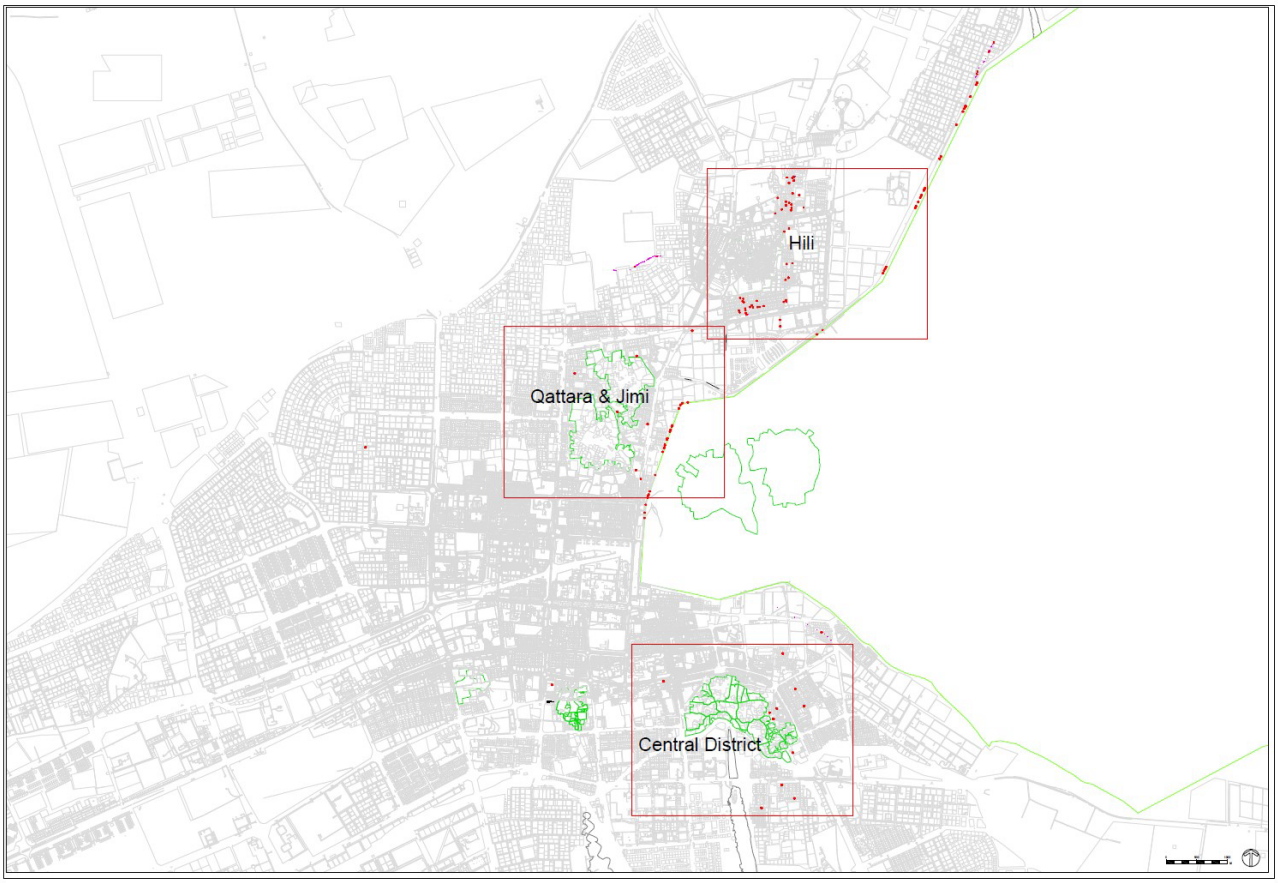

Figure 1. Distribution map of more than 150 Aflaj discoveries across Al Ain

Ain, many discoveries—including newly identified Aflaj— are often encountered in the course of urban expansion rather than through planned archaeological excavations. As a result, heritage management becomes reactive, negotiated between conservation ethics and urban development timelines. This raises a core dilemma: how can a city uphold its global heritage obligations when its discoveries are both accidental and logistically difficult to preserve or present?

Within this complex landscape, the HED plays a central role in negotiating the intersection of development and preservation. Unlike static heritage sites with clearly defined boundaries, the Aflaj discoveries in Al Ain often occur in active construction zones, requiring rapid assessment and decision-making. Through formal coordination mechanisms, HED reviews proposed development plans, conducts emergency surveys, and intervenes when cultural assets are at risk. These workflows reflect a locally adapted model of heritage governance: one that aligns with UNESCO’s emphasis on safeguarding authenticity and integrity, while also acknowledging the need for practical flexibility in fast-growing urban contexts. In doing so, Abu Dhabi is beginning to articulate its own heritage policy language—rooted in responsiveness, technical rigor, and inter-agency cooperation.

2.2 Archaeology in an Expanding Urban Landscape

Building on this context of negotiated heritage governance, the actual discovery and handling of Aflaj sites reflects a uniquely embedded urban practice. While international heritage frameworks often assume clearly defined and legally protected sites, the reality on the ground in Al Ain is far more dynamic. The Aflaj systems uncovered throughout the city were not the product of planned excavation campaigns, but emerged instead amid rapid urban expansion. Their appearance—sometimes beneath roads, building foundations, or parking lots—reminds us that these ancient infrastructures, though hidden, continue to shape the spaces above them.

As part of a proactive preservation strategy, the Historic Environment Department (HED) developed formal procedures with municipal authorities to oversee urban development. All construction proposals are now screened for archaeological risk, and when a site of potential significance is identified, HED steps in—conducting early assessments, focused excavations, and determining appropriate measures: documentation, in-situ preservation, or mitigation of the proposed impacts

Over time, this responsive approach has matured into a structured system built on constant monitoring, targeted risk-zone surveys, and adaptable field practices. HED teams routinely observe construction activity, respond to site disturbances caused by infrastructure work or environmental conditions such as heavy rain, and revise their workflows accordingly. These findings are not remote—they surface amid daily life: in residential areas, road networks, and utility corridors. In this context, archaeology becomes a quiet but integral part of urban planning, subtly influencing decisions and revealing the city’s buried layers of history.

Figure 2. Excavation of a falaj shaft emerging beneath modern urban infrastructure.

2.3 Multi-Model Documentation for Urban Archaeology

These field-based practices laid the groundwork for a more enduring solution—digitization. In a World Heritage context like Al Ain, archaeological documentation is not merely good practice; it is a cultural obligation. In line with this mandate, the Historic Environment Department (HED) developed a robust documentation workflow aligned with international standards for the creation of verified digital heritage assets.

Whether documenting ancient Aflaj or other archaeological features, the department employs an advanced, multi-tiered methodology designed for both responsiveness and scientific integrity. This includes total station surveys for geodetic control, UAV-based aerial photogrammetry to capture spatial relationships and surface traces, and high-resolution 3D recording via close-range photogrammetry and terrestrial laser scanning (LiDAR). All outputs are georeferenced within a GIS environment, ensuring contextual integration with planning datasets and mapped risk zones. Site-specific records capture archaeological features, conditions, and interpretations using structured context-based systems. Resulting datasets—point clouds, orthophotos, textured meshes, and metadata—are processed into optimized formats for integration into the digital platform. In areas where excavation was restricted, the team applied non-invasive strategies to preserve partial visibility and allow for digital continuity.

As the number of discoveries grew—ultimately surpassing 150 locations and over 60 distinct Aflaj—the value of this data extended far beyond technical documentation. Each Falaj is not simply a structural remnant, but a trace of communal ingenuity embedded beneath the living city. The density, scale, and continuity of these findings created a compelling opportunity: to reinterpret professional field data as a cultural asset and public interface.

The Aflaj Discoveries platform emerged not as a planned outreach tool, but as an organic response to this growing archive of buried infrastructure. Shaped by the increasing volume of discoveries, the significance of their context, and evolving policy frameworks, the platform reflects the civic role of archaeology as much as its technical one. It exemplifies how reactive fieldwork, when paired with structured workflows and digital tools, can evolve into inclusive, future-oriented cultural infrastructure.

2.4 Designing for Access: Technical Architecture of the Platform

The Aflaj Discoveries platform was envisioned not merely as a visualisation tool, but as an accessible, interactive environment that allows users to engage with complex archaeological data in intuitive and meaningful ways. Its interface draws on familiar digital behaviours, mirroring common navigation patterns such as interactive mapping and layered content presentation, while concealing a technically sophisticated architecture built entirely on browser-based technologies.

At its core lies a satellite map of Al Ain rendered using Mapbox, with geo-located discovery points dynamically connected to structured CMS entries in Webflow. Each point opens a dedicated site page containing a navigable 3D model hosted via Sketchfab, created using high-resolution photogrammetry and laser scanning. These models are uploaded in GLB format with baked textures, pre-assigned materials, and defined annotation points. A custom viewer—developed using the Sketchfab JavaScript API—is embedded within the site, enabling dynamic highlighting and real-time annotation retrieval. This setup supports AR and VR features that allow users to virtually step inside Falaj shafts, view internal structures, or project reconstructions into their physical surroundings through mobile AR.

Content management is streamlined through Webflow’s no-code CMS, allowing non-technical editors to add or modify site entries, upload media, and manage multilingual metadata without backend development. Mapbox layers are styled via NoCodeFlow and linked directly to the CMS for seamless discovery publishing. This modular architecture minimizes reliance on external servers, preserves editorial control, and ensures scalable performance across devices.

This layered design is particularly valuable for users who face physical, geographical, or sensory barriers to accessing traditional archaeological sites—such as elderly individuals, those with mobility limitations, or people living outside the UAE. By eliminating these constraints, the platform supports more dignified, self-paced engagement with heritage from the comfort of home, in Arabic or English, and across browsers and devices.

In addition to site content, the platform hosts several key sections that reinforce transparency and participation. The Publications page allows users to access official excavation reports, academic articles, and public outreach materials produced by the Historic Environment Department. The People section highlights the contributions of various institutional partners, contractors, and public entities. More significantly, it gives visibility to the many behind-the-scenes contributors—field technicians, support teams, and local workers—whose efforts often go uncredited in public-facing heritage narratives.

This human dimension is central. The documentation of Aflaj systems is not a solitary achievement—it is the result of coordinated fieldwork, institutional support, and public cooperation. In many cases, community understanding and logistical flexibility on the part of residents allowed for excavation work to proceed in sensitive or high-traffic areas. The platform provides space to honour these contributions. By listing excavation teams, mapping live or ongoing investigation zones, and offering a direct contact page, the interface invites further participation. It opens a door for researchers, students, and curious residents to connect with the HED team, propose collaborations, or simply stay informed about where work is happening across the city.

Ultimately, the platform reframes archaeological access—not only through visualisation, but through recognition and inclusion. It gives presence to heritage that is physically

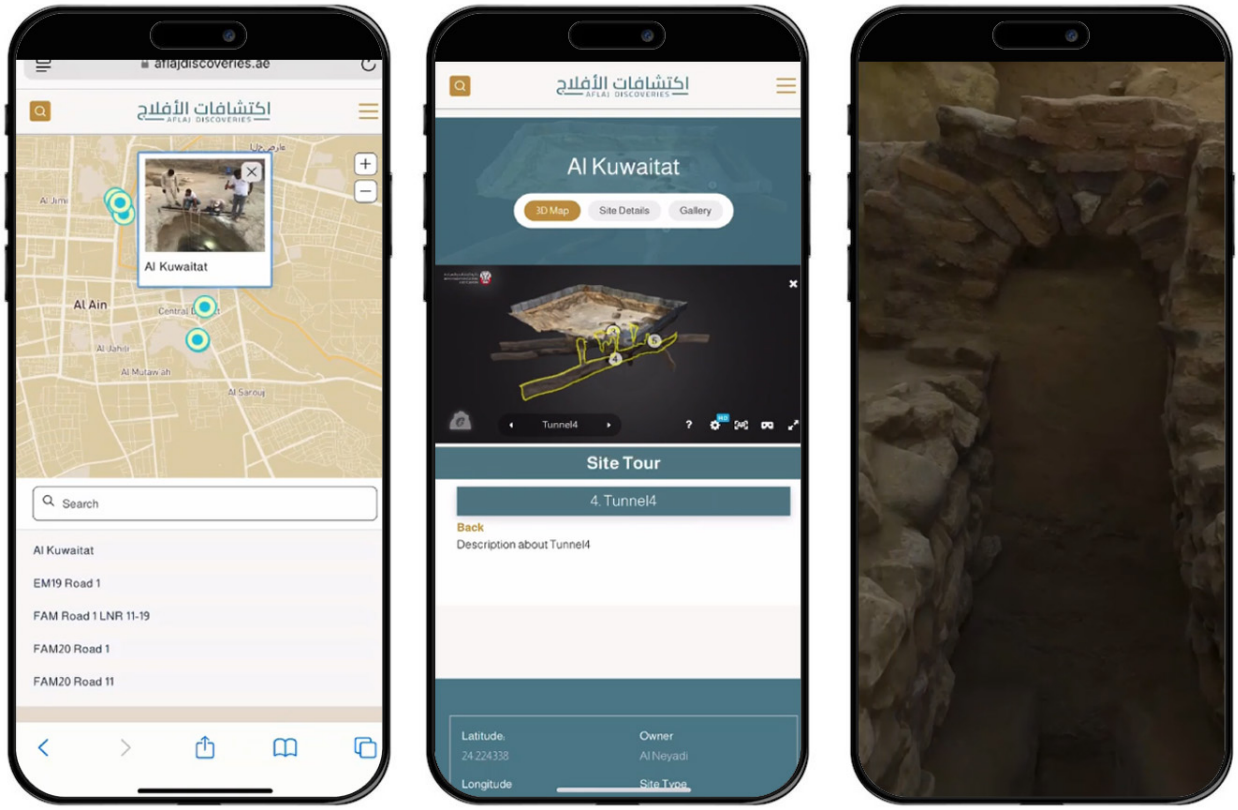

Figure 3. UI of the Aflaj Discoveries platform showing interactive AR VR features.

invisible, and voice to the collective labour that brings it to light. In doing so, it transforms digital heritage from a passive archive into an active, participatory infrastructure—where anyone can see, learn, and eventually contribute

2.5 Viewer Design as a Tool for Cultural Engagement

The Aflaj Discoveries platform does more than present archaeological data—it curates a cultural experience through visual strategy. By adopting a familiar interface modelled on everyday digital behaviours, the application transforms unfamiliar heritage into an accessible, emotionally resonant journey. Its visual language—centred around an interactive map, clickable discovery points, and smooth transitions into 3D environments—intentionally mirrors how people navigate tools like Google Maps or virtual tours. This design lowers the cognitive threshold for engagement, enabling users of varied backgrounds and abilities to explore intricate archaeological narratives without feeling excluded.

At the core of this experience lies a custom-built 3D viewer, embedded within the website and powered by Sketchfab’s JavaScript API. Unlike the default Sketchfab interface, this tailored viewer offers full control over presentation, interaction, and data flow. Each 3D model is uploaded in optimized GLB format with pre-assigned annotation points and distinct material codes. When users interact with the model—whether through clicks or hover actions—the viewer dynamically highlights features and retrieves annotation content from the API, displaying it in a collapsible side panel. This dual-layered experience merges spatial orientation with narrative depth, supporting structured storytelling and intuitive navigation.

Annotations are authored manually via Sketchfab’s editor, marking key points of interest and pairing them with curated content—text, images, or embedded videos—enhanced through Markdown formatting. Independently, a visual highlight layer tracks user interaction with specific materials embedded in the model, enabling colour-based feedback for orientation and focus. This separation of content logic and visual signalling allows the viewer to guide interpretation without overwhelming the user.

Crucially, these technical layers are designed not as isolated features, but as instruments of cultural translation. By embedding 3D reconstructions within recognizable urban context—complete with topography, streets, and neighbourhood references—the platform anchors archaeological findings in personal memory and local geography. For the Aflaj, this spatial embedding is especially meaningful: it reconnects ancient water infrastructure to the modern city it once sustained, turning invisible systems into visible heritage.

Ultimately, design here is not a passive wrapper, but an active cultural agent. Through responsive interaction, immersive visuals, and contextual anchoring, the platform reframes engagement with heritage—not as distant observation, but as embodied interpretation. The custom viewer plays a central role in that shift, not only enhancing accessibility but enabling users to co-navigate and co-construct the experience of remembering.

3. Urban Memory

3.1 Case Studies: Falaj Al Mazmi and Al Kuwaytat

Two case studies featured on the Aflaj Discoveries platform offer compelling examples of how deeply buried, temporally layered hydraulic systems can reshape both archaeological understanding and public perception of urban space.

The first, *Falaj Al Mazmi*, represents the most extensive example of an Iron Age Falaj and its related field system documented in Al Ain to date. Spanning over 800 meters beneath a fully urbanised residential district, the Falaj was uncovered in ten separate locations between 2019 and 2024—not through targeted excavations, but as isolated discoveries that emerged during infrastructure works such as drainage lines, road repairs, and even private housing construction. These segments were not found in sequence nor aligned in a straight line; instead, each fragment surfaced independently according to the pace and location of the modern development projects being monitored by the Historic Environment Department. Together, they form a network that crosses an entire neighbourhood, revealing the presence of a continuous system that once channelled water through what is now a densely built-up environment. At the downstream end of the system, excavations revealed traces of an associated agricultural area, confirming the Falaj’s original function as a tool of oasis cultivation. Importantly, the discovery is still considered incomplete: future interventions may reveal additional segments, while some parts—based on accumulated evidence—are known to pass beneath active buildings and cannot be excavated. These invisible segments are nevertheless acknowledged and visualised in the platform, serving both a scientific and educational function by demonstrating that archaeological discoveries often lie beneath living cities, and that heritage management must be flexible, non-invasive, and culturally sensitive.

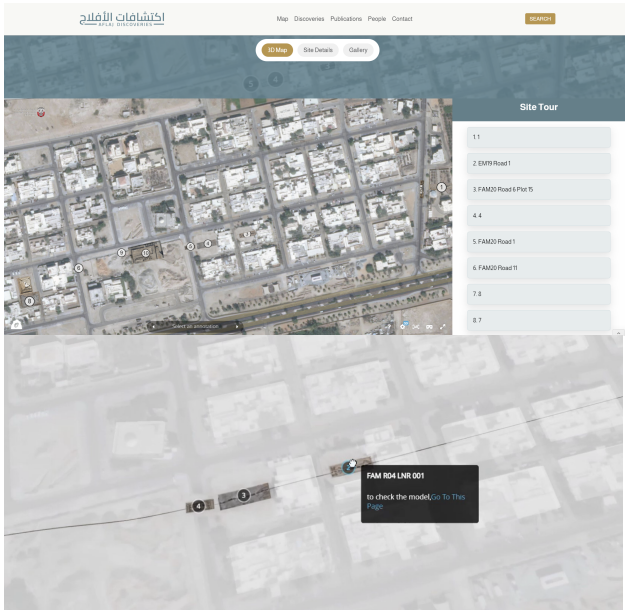

Figure 4. Interactive 3D reconstruction of Falaj Al Mazmi showing system continuity across ten discovery points.

The second case, from *Al Kuwaytāt*, presents a different kind of complexity. Unlike Al Mazmi, where segments are spread across an extended area, the entire discovery here occurred within a single construction site. Five distinct Aflaj were found stacked vertically within the same footprint, representing different historical periods—from the Iron Age through the late pre-Islamic era to the Late Islamic period—and positioned at varying depths ranging from approximately 5 to 15 metres. Unlike typical cases of reuse, the systems in Al Kuwaytāt show no intentional integration. In one striking instance, a later Falaj cuts directly through an earlier one without architectural adaptation, suggesting that builders were unaware of the older structure’s presence—likely due to the absence of any surface indicators. This intersection highlights the challenges of tracing continuity in deeply stratified urban environments, where successive generations may unknowingly build over buried heritage.

The Aflaj Discoveries platform plays a central role in clarifying these layered discoveries and making them accessible to non-specialists. For the Al Mazmi Falaj, the platform offers a unified 3D model that integrates all ten segments into one spatial environment, allowing users to see how each site fits into the larger system. Each discovery point is clickable, opening a dedicated site page where users can explore excavation photos, read site-specific context, and access technical documentation. While the model is optimised for smooth online exploration, a separate version has been configured for augmented reality (AR), allowing users to project shafts and channel elements into their real physical surroundings at 1:1 scale. This option enhances spatial understanding by enabling users to perceive the human-sized dimensions of the Falaj, not just its form.

In the case of Al Kuwaytāt, the five overlapping Aflaj are visualised in a single 3D model, with each Falaj shown in a different colour—not just to reflect chronology, but to provide a visual aid for navigating the dense layout. Users can toggle between elements, view their vertical relationships, and access detailed metadata about each system. Together, these models help users grasp the temporal and spatial complexity of the site in a way that conventional site plans or written descriptions cannot.

By assembling these discoveries into richly layered, interactive visualisations, the platform transforms fragmented archaeological data into a coherent public resource. It allows users not only to understand what was found, but to experience how it fits—physically, historically, and socially—within the city they inhabit.

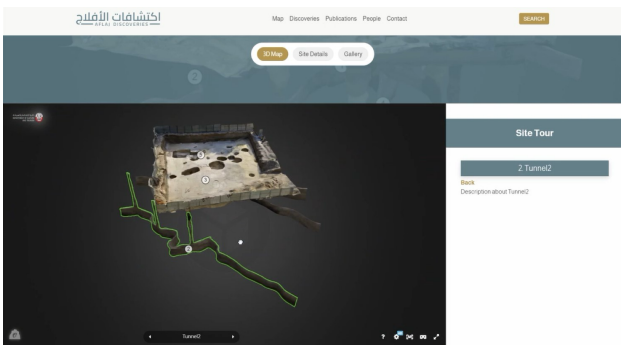

Figure 5. visualization of overlapping Aflaj at Al Kuwaytat.

3.2 From Invisibility to Immersion

The challenge, then, is not only technical—it is emotional and perceptual. If what is lost in invisibility is a sense of presence and ownership, then the design of digital heritage platforms must do more than display data; it must invite users into a reimagined relationship with place. This is the ethos behind the Aflaj Discoveries platform’s interface: to transform distant, concealed, or erased sites into lived experiences—familiar, yet profound.

3.3 What is Lost When Heritage Remains Unseen

Yet, even the most advanced documentation remains limited if its results are never seen or felt by the public. When archaeological findings remain hidden—whether sealed

underground, dismantled after documentation, or archived out of public reach—what vanishes is not just material evidence of the past, but the opportunity for people to connect with it. In cities like Al Ain, where ancient systems such as the Aflaj run silently beneath today's infrastructure, this sense of detachment becomes especially pronounced. Residents unknowingly traverse their heritage each day, without seeing, touching, or recognizing the layers of history shaping their surroundings. These underground channels—once the lifeblood of the oasis—still echo stories of movement, cultivation, and shared survival, even when unseen.

The lack of visibility erodes emotional and cultural bonds between communities and their history. It reinforces a model where heritage is controlled and narrated solely by experts, rather than co-experienced and remembered by all. Without access to images, spaces, or narratives, the past dissolves into abstraction—reduced to static reports and disconnected displays. And this detachment matters. It weakens the sense of place, interrupts cultural continuity, and diminishes the public's capacity to advocate for preservation or reflect on the meaning of their past. The Aflaj Discoveries platform seeks to counter this erosion—not by recreating the physical sites, but by offering an immersive, layered digital experience that allows users to visualize, explore, and reinterpret what lies beneath their feet. In doing so, it reframes heritage not as distant knowledge, but as a living thread woven through the modern urban fabric.

4. From Case to Policy

4.1 Platform Practise as Policy Instrument

The case studies from Al Mazmi and Al Kuwaytāt demonstrate the layered complexity of archaeological discovery in Al Ain—revealing how urban growth and hidden infrastructure intersect in unexpected ways. Yet beyond their physical significance, these discoveries illustrate how raw field data can be transformed into civic value. The Aflaj Discoveries platform does more than visualise: it repositions archaeological heritage as shared public knowledge, accessible and meaningful to all.

This shift—from excavation to interface—reflects a broader institutional evolution. Under the Historic Environment Department's mandate, documentation is not merely a technical record—it is a tool for public awareness and cultural continuity. Systems like the Aflaj, which embody resilience and ingenuity, are treated not only as artifacts to preserve, but as narratives to share. Through the platform, these narratives gain presence, voice, and visibility.

The approach aligns with Abu Dhabi's cultural vision, which frames heritage as both infrastructure and public asset. While the platform echoes global calls for participatory heritage—such as UNESCO's emphasis on community access—its design emerged from local needs: emergency discoveries, rapid urban development, and the demand for transparency. Rather than enforcing engagement from above, the platform fosters it through structure, language, and tools.

In this way, the Aflaj Discoveries platform becomes more than a digital experiment—it is an operational extension of policy. It embodies principles of inclusion, accessibility, and knowledge equity, using digital systems to enact heritage values in real time. It invites the public not just to observe heritage, but to inhabit it—spatially, emotionally, and socially.

4.2 Evaluating Impact: From Local Innovation To Global Discourse

While the Aflaj Discoveries platform marks a visible shift in how cultural heritage is shared and conceptualized, its long-term impact remains difficult to measure. In a domain often governed by metrics of preservation or academic output, there is little consensus on how to evaluate digital tools designed for public engagement. Is success defined by visitor numbers? User diversity? Narrative comprehension? Or by subtle shifts in how people perceive their city's hidden heritage?

At present, no formal framework exists to assess how users engage with the platform or whether access influences public awareness, participation, or policy discourse. Yet this gap presents an opportunity. As the platform matures, structured collaborations—with schools, universities, and tourism networks—could yield both qualitative and quantitative insights. Academic partnerships might explore the role of digital interaction in shaping heritage literacy, while analytics can track usage patterns and demographic reach.

More than an evaluation challenge, this is a question of intent. To make heritage truly public, we must also measure how it is being received. For Aflaj Discoveries to grow beyond its prototype phase, impact assessment must be built into its future design—not as a technical feature, but as a core element of its civic function.

4.3 Platform Constrains and Latent Opportunities

Despite its promise, the Aflaj Discoveries platform currently operates within structural and operational limitations. As a pilot built by a small, specialized team, it lacks dedicated personnel for key functions such as content development, translation, legal oversight, and digital asset management. While the curated content is robust, it represents only a fraction of the documented discoveries. Much of the 3D data remains under refinement or pending publication.

Technical constraints have also shaped the platform's architecture. To ensure smooth performance across devices, 3D models required strict optimization—typically under 50,000 polygons and compressed in GLB format. Sketchfab's real-time rendering imposed further limits on texture size and annotation volume, requiring careful model preparation and content segmentation.

Integrating multi-layered content into a no-code CMS also introduced friction. Webflow and NoCodeFlow enabled rapid deployment, but syncing geospatial logic and 3D metadata across systems sometimes led to versioning conflicts. These were mitigated by role-specific publishing workflows and centralized documentation protocols.

Legal and data governance posed additional challenges. While hosted content is government-owned, reliance on third-party platforms like Sketchfab complicates intellectual property control. UAE data protection laws further restricted the implementation of user feedback or location-based features, preventing storage of user data on non-local servers.

Strategically, the platform's future depends on how it interfaces with larger heritage ecosystems—particularly the Abu Dhabi Historic Environment Record (ADHER). While ADHER provides professional-grade regulatory data, it lacks immersive features. Whether to integrate, align, or separate the two remains an open policy question. Additionally, the absence of a structured outreach framework limits public engagement from schools, tourism entities, and municipal partners.

Yet these limitations also reveal latent potential. The platform could expand thematically to include other types of discoveries—such as tombs, agricultural zones, or domestic

features—collected during emergency excavations. It may also invite community-contributed content, enabling a curated model of co-authorship with students, researchers, or local residents.

Ultimately, these constraints do not undermine the platform's value—they clarify its roadmap. As a proof of concept, Aflaj Discoveries demonstrates what is possible. Its evolution depends not just on expanding content, but on strengthening its operational foundation, aligning with national policies, and investing in sustainable governance.

4.4 Future Scenarios: Integrating Local Infrastructure with Global Practice

As cultural heritage platforms proliferate globally—from UNESCO's *Dive into Heritage*, to Egypt's *Theban Mapping Project*, to the UAE's own *Sharjah Collects*—the Aflaj Discoveries platform offers a distinct model rooted in site-specific immediacy and civic relevance. These projects vary in structure and purpose: *Dive into Heritage* serves as a regional aggregator focused on enhancing digital visibility for UNESCO sites, often prioritising scale over intimacy. The *Theban Mapping Project*, one of the earliest and most methodologically rigorous digital heritage efforts, exemplifies large-scale planning and architectural mapping within a controlled necropolis environment. Meanwhile, *Sharjah Collects* provides institutional-level access to museum holdings and archaeological collections, with a strong curatorial and cataloguing lens.

Aflaj Discoveries, by contrast, emerges not from monumental visibility nor from controlled museum spaces—but from the friction points of urban life. It is built atop discoveries made in real time, through rescue excavations beneath parking lots, road corridors, and residential infrastructure. The platform's power lies in its responsiveness: it captures heritage as it re-emerges, in fragments, amid development pressures. It does not frame the past as an object to observe, but as a presence to navigate.

Importantly, the potential of the platform extends beyond the aflaj. Al Ain's archaeological landscape includes monumental tombs from the Hafit and Umm an-Nar periods, mudbrick residential compounds from the Late Islamic period, Iron Age falaj-fed agricultural systems, and shifting settlement patterns that reflect trade, migration, and environmental adaptation. These records already exist—scattered across documentation archives, geospatial datasets, and excavation reports within HED's internal systems. Aflaj Discoveries can serve as the interpretive skin that brings them together.

Expanding the platform thematically would transform it into a holistic interface for reading the city. Instead of accessing isolated site records, users could experience how burial, water, agriculture, and habitation intersect across time and space. For example, a user might view how an Iron Age tomb lies downstream from a falaj line, which in turn nourished a later agricultural plot, now buried beneath a modern housing development. Such interlinkages offer not just historical information, but cultural literacy—training the public to see their environment as an evolving palimpsest of lives, systems, and adaptations.

At the global level, this model offers a new benchmark. While *Theban Mapping* provides depth within a monumental zone, and *Dive into Heritage* offers breadth across select iconic sites, Aflaj Discoveries has the potential to do both: to be spatially granular and thematically expansive. Its integration of immersive tools, real-time field response, community-focused design, and multi-scalar storytelling places it at the cutting edge of what digital heritage can become—especially in urban, continuously inhabited landscapes.

This specificity makes the platform uniquely positioned to reflect—and shape—a localized form of digital heritage policy. Yet its potential also lies in alignment with broader systems. The Abu Dhabi Historic Environment Record (ADHER), developed by the same department, offers a professional, regulatory-grade heritage register—rich in metadata, conservation status, and institutional workflows. If integrated, Aflaj Discoveries and ADHER could function as a complementary system: the former as a civic interface, the latter as a planning tool.

Moving forward, harmonising metadata, refining access layers, and adopting shared ethical protocols could establish Aflaj Discoveries as a model for how public-facing heritage platforms can coexist with back-end regulatory systems. Collaborations with regional and global partners would further strengthen this vision, not by imitating existing models, but by demonstrating how buried, invisible heritage can become publicly visible, emotionally resonant, and policy-relevant.

With the right strategic foresight, the platform can transcend its pilot stage—not simply by growing in size, but by deepening its cultural function. It can become not just a window into the past, but a working instrument of heritage governance—designed in Al Ain, relevant far beyond it.

5. Conclusion

5.1 Reframing Access, Reimaging Responsibility

The Aflaj Discoveries platform began as a response to urgent challenges—unplanned excavations, fragmented documentation, and the invisibility of heritage beneath a rapidly changing city. But through its evolution, it has become something more: a redefinition of how archaeology is made public. It frames heritage not as a static legacy to preserve, but as a living system woven into everyday life—something to visualize, interpret, and share.

By mapping over 150 sites and more than 60 distinct Aflaj systems—many of them inaccessible or fragmented—the platform transforms data into experience. It uses familiar, emotionally resonant tools to invite users into a dialogue with place, memory, and urban history. It doesn't just display what was found—it reactivates what has been buried, materially and culturally.

This paper has argued that the platform's impact lies not only in its digital architecture, but in its conceptual framing. It acts as an instrument of cultural governance, embodying Abu Dhabi's commitment to inclusive heritage policy and civic participation. In doing so, it offers a new model: responsive, accessible, and deeply situated in local context—yet scalable to global practice.

To sustain this momentum, future work must focus on impact assessment, content expansion, and deeper integration across heritage, education, and planning systems. In that process, Aflaj Discoveries can mature from a prototype into a durable public infrastructure—not only visualizing the past, but shaping how we carry it forward.

Acknowledgements

The authors would like to thank the Department of Culture and Tourism – Abu Dhabi for supporting the project's vision and enabling its realization, and the Historic Environment Department for fostering an environment in which this work could be conceived and developed. Special recognition is extended to Anas Bahnini, Ashok Lahiri and Rajeev Bhagat from the Technology Department for leading the platform's development and delivery as project managers.

We acknowledge AVITech as the platform’s development partner, with appreciation to team members Eman, Mohammed, Rasheed, Ahmed, and Michael for their dedicated contributions throughout the project lifecycle. We also thank GeoTech and Leica Geosystems DMCC for their targeted technical support during the surveying and documentation phases.
Finally, sincere appreciation is extended to all contractors, partner entities, and on-site collaborators who supported data collection across the city, as well as to the project’s core archaeological and field teams—whose efforts made these discoveries and this platform possible.

References

Alhammadi, T.Y., Cuttler, R.T.H., Beech, M.J., El Faki, A.A., 2024: Developing a Historic Environment Record system for the management of heritage resources in the emirate of Abu Dhabi. In: *Advances in UAE Archaeology: Proceedings of Abu Dhabi’s Archaeology Conference 2022*, Archaeopress, Oxford, 429–446.

Bekele, M.K., Pierdicca, R., Frontoni, M., Malinverni, P., Gain, E., 2018: A survey of augmented, virtual, and mixed reality for cultural heritage. *Journal on Computing and Cultural Heritage*, 11(2), 1–36.

Dallas, C., 2016: Digital curation beyond the museum: archaeological data management as shared scholarly infrastructure. *Open Archaeology*, 2(1), 232–250.

Dive into Heritage, 2022: Platform Overview and Technical Notes. United Nations Educational, Scientific and Cultural Organization. https://diveintoheritage.org

Eissa, M., 2023: Heritage Visualisation Strategies in the Gulf: Mapping Subterranean Narratives. In: *Proceedings of the Digital Heritage Middle East Conference*, Sharjah.

Sharjah Archaeology Authority, 2022: Collects Platform. https://collects.sharjaharchaeology.ae

Sheehan, P., Khalifa, M., Al Ajou, M., Al Marzooqi, N.N., 2023: Secrets of the shaabiyat: recent developments in the archaeology of the (urban) oasis landscape of Al Ain. In: *Advances in UAE Archaeology: Proceedings of Abu Dhabi’s Archaeology Conference 2022*, Archaeopress, Oxford, 293–306.

Theban Mapping Project, 2023: Theban Mapping Project Website. https://thebanmappingproject.com

UNESCO, 2022: Dive into Heritage official website. United Nations Educational, Scientific and Cultural Organization. https://diveintoheritage.org

Vileikis, O., Rigauts, T., Rouhani, B., Ziane Bouziane, M., Santana Quintero, M., 2023: Dive into Heritage: A digital documentation platform of World Heritage properties in the Arab States region. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLVIII-M-2-2023, 1613–1620. https://doi.org/10.5194/isprs-archives-XLVIII-M-2-2023-1613-2023