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The Use of Generative AI in an Interdisciplinary Approach for Cultural Preservation

David Graham[1]

1 University College Dublin

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Abstract

Generative Artificial Intelligence (AI) has become a powerful tool to create new worlds and inject meaning into staid environments. A process of transforming physical space into digital assets becomes necessary to ensure that culturally relevant objects can persist through the changing tides of society. This paper highlights a process whereby physical assets can be digitized and utilized within a generative AI environment while preserving provenance, authenticity, and veracity. It concludes with salient use cases and a discussion that hopefully will lead to more action.

Overview

The concept behind using Generative AI in an interdisciplinary approach for cultural preservation is premised on creating or incorporating assets into a digital landscape or metaverse to sustain and preserve known physical objects or other culturally significant items. This allows for nation-states, governments, communities, or societies to preserve intrinsically valuable items while simultaneously extending their reach into nascent domains. It can be viewed as a type of technological anthropology, designed to persist culture through the rapid, evolutionary changes of a digital world.

In this paper, technological methods for the capture and digitization, curation, and dissemination of culturally significant objects along with salient use cases utilizing the methods will be discussed. Finally, a discussion of appropriate roles and responsibilities within the technological anthropology aegis this was written will provide conclusory thoughts.

Methods

The concept discussed here is designed to bring together multiple different types of emerging technologies to achieve a fully digitally preserved culture. It is comprised of several steps or stages that include *Capture and Digitization*, *Curation*, and *Dissemination*.

Capture and Digitization

We can digitize cultural assets using a wide variety of technologies. Some of the technologies being used here are *photogrammetry*, *neural radiance fields* (NeRF), *light detection and ranging* (LiDAR), as well as other types of capture methods not listed here. Similar technologies are used within digital twin communities with great effect.

The use of *photogrammetry* for initially capturing cultural assets, be it a lighthouse, a church, a building, art, sculpture, and incorporating that into a metaverse or a digital asset

library for a particular culture, place, state, or otherwise enables the first step towards digital preservation. Using photogrammetry, an overarching description of an asset's physical state can be preserved in several ways.

Figure 1. Hvalnesviti, an Icelandic lighthouse on the eastern shore

As seen in Figure 1, the use of a digitally captured or photogrammetric representation of a lighthouse from Iceland can be propagated into any number of places. It could be inserted into in games based around Epic's Unreal Engine, for example, or for use in digital film sets built by media studios. The ability to "world build" using contemporaneous representative buildings or cultural assets becomes uniquely important.

Curation

The second step after capturing an asset is to incorporate it into a catalog with some measure of *tracking*, *traceability*, and

persistence as a means of establishing a curative process as well as provisioning for dissemination. This isn't as simple as creating a unique CRC or an MD5 checksum for these assets even though those are intrinsic to the initial creation process. Because assets can be used any number of ways and be represented in any number of places, *as noted in the previous example of Unreal Engine*, novel methods of cataloging for tracking and traceability must be used. If no concept of actual preservation exists, it blunts the effect that technology can provide to the larger process of technological anthropology.

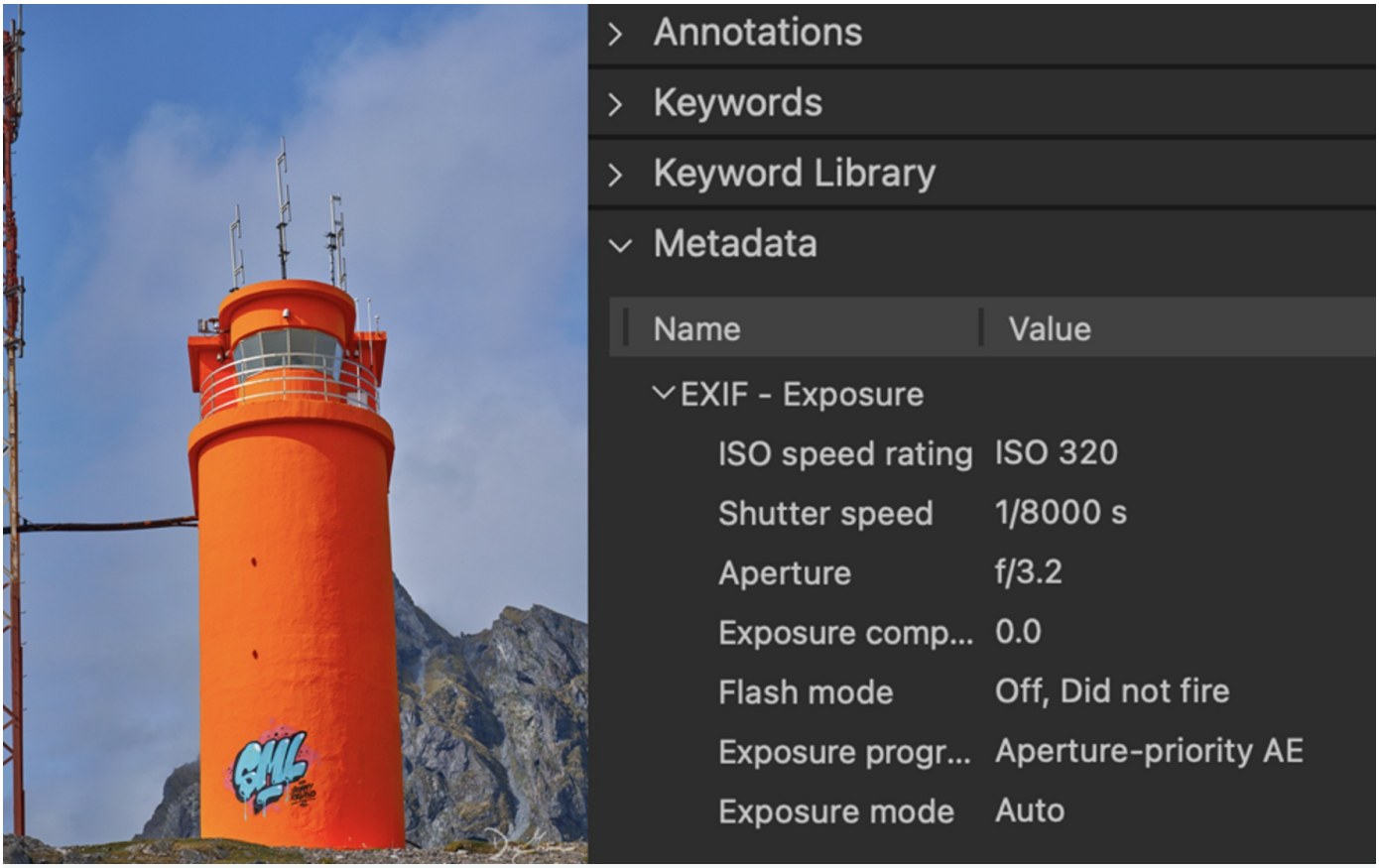

Figure 2. An example of simple meta data tagging for curation

Tagging

Using the same Icelandic lighthouse image as before, Figure 2 denotes a simple application exchangeable image file format (EXIF) metadata tagged to the original image. Other types of metadata could be appended to this file including color, building type, geographic information systems (GIS) data, latitude and longitude, country, region, and such. This type of process isn't novel, having been used for many years in systems like Adobe's Lightroom, Capture One, Dassault System's 3DExperience, picture archiving and communication systems (PACS), and others using a variety of containers or wrappers.

Traceability and Persistence

Once tagging has been completed, the asset ingestion into a catalog can begin. To comply with open records and data privacy laws, a method of traceability, driven by technology, is necessary. To accomplish this while maintaining auditability, nascent technologies such as Hedera or Alvarium, could be used whereby a specific entry to a broadly decentralized ledger system is created. This ledger could be sovereignly created, that is, by the government of Iceland as an example, but would be presented in such a way as to provide auditable assurance and traceability of the ingested assets[1].

It must be noted that, given the nature of generative artificial intelligence (AI) tools, decisions on the type of catalog must be understood to conform to a readable semantic used by common large language model (LLM) algorithms. Typically, these catalogues use vector databases containing the embeddings representing their data sets. These are primarily driven off both filesystem as well as file semantics and their associated meta data. This process can be done in parallel to ingest into a digital ledger and it remains to be seen how the inevitable collision between traceability and persistence affects usage within LLMs or other diffusion-based modeling systems.

By creating an asset that now is tracked and cataloged in the curative processes noted in previous sections, visibility is granted to its eventual use.

Dissemination

In the final step, dissemination, a prototypical catalog of cultural assets has been created with appropriate metadata tags and entries into a digital ledger. By collecting all these assets together into a unified location, we now have a catalog of assets that can be now disseminated or accessed by agencies, entities, or enterprises while maintaining accountability for usage.

A practical example of this utilizing the previous illustration of Unreal Engine is as follows: a media company wants to use a digital embodiment of Hvalnesviti lighthouse. They determine the asset is part of an Icelandic cultural database and procure the asset through their provide, Unreal Engine. In the background, Unreal Engine engages with the Icelandic digital ledger, places an entry denoting customer, usage case, or other required information including transaction fees, and this is persisted in an open fashion and recorded. Based on the custodial relationship that Iceland has with the provider, such an entry will allow them to understand the usage of their cultural heritage models.

This example provides accountability for the use of that asset in ways that previously were brokered by agencies like Getty, Wirestock, 500px, or otherwise. While those systems have their role, the advent of newer, decentralized, and transactionally focused systems as highlighted above, merit consideration.

Use Cases

Having discussed the process for the capture and digitization, curation, and dissemination entertainment, it is pertinent to discuss the circumstances where such processes could reasonably function.

Technology and Culture

The use of technology for creating worlds or experiences isn't new. From the advent of cave wall paintings in Neolithic times to Renaissance art to our contemporary, digitally driven cinematic studios, humanity has always sought to preserve through creation. In contemporary society, the advent of digital worlds, as created for films like Star Wars and Game of Thrones, legitimizes the creation of digital assets for use within this creative process. Culture, typically a bystander to this process, needs to find its representation there as well. The shift to digitally native world building gives cultures the ability input into these scenarios, scenes, and technologies where their disappearance has a higher than likely chance. By promulgating these assets through various types of media, the idea of maintaining cultures and spaces, using the natural resources and ideologies close at hand becomes tangible.

Cultural Use Case: Iceland

Iceland, given its history tumultuous geologic activity and susceptibility to global warming, could at any point find culturally relevant sites destroyed. Cultural persistence becomes something that is sacred and fundamental. An examination of at-risk features and functionalities, heritage sites like lighthouses and churches, can be incorporated into the process for applying to future states of the nation.

Process Flow

Using Hvalnesviti, an example process for digital incorporation would proceed along the following steps:

1. *Capture* Hvalnesviti using any number of digitizing technologies such as photogrammetry, NeRF, LiDAR scanning from either aerial (drone) or ground-based solutions. Utilizing software such as Dassault System's 3DExperience, Epic's RealityCapture, or otherwise, create the point cloud and associated digital traces to establish Hvalnesviti as a digitally instantiated entity.
2. *Curate* this digital Hvalnesviti by ensuring that metadata is updated and correlated, including all salient information related to physical location, description, composition, and otherwise and append to an established National Register of Lighthouses catalogue using Alvarium.
3. *Disseminate* the digital Hvalnesviti via common marketplaces such as the Unreal Engine marketplace utilizing, wherever possible, extant links through a common decentralized network for authentication and preservation. An integration point between the Unreal Engine marketplace and an Icelandic-government run digital ledger instance of Hedera, for example, would be instrumental in maintaining provenance and privacy. As assets are used for building new environments through these marketplaces, the ledgers will be updated.

Because of the difference in diffusion-based modeling as used in Stable Diffusion, Midjourney, and Dall-E, the process of digital propagation appears slightly different from step two onward. In the case of pure generative use cases, the augmented steps would be:

1. *Curate* digital Hvalnesviti by ensuring that metadata is updated and correlated, including all salient information related

to physical location, description, composition, and otherwise and append to an established National Register of Lighthouses catalogue using Alvarium. Further, collating these captured digital assets into a training catalogue that can be supplied to the different entities for inclusion in their diffusion training sets is necessary.

2. *Disseminate* the digital Hvalnesviti and associated asset catalog to entities like Hugging Face, OpenAI, et al to ensure fair representation of culturally significant assets within the generative space to allow for more directed results based on common textual prompts. Alternatively, establish a text-to-image prompting space under the aegis of the Cultural Heritage Agency of Iceland[2] to allow for the direct creation of digital assets that rely on culturally appropriate imagery as part of their diffusion model.

Digital Twin

Another use case of this digitization process is that of creating digital replicas or digital “twins” of cultural assets and placing them in a real-time feedback loop. Since any asset that’s being captured represents a complete digital model in situ, the ability to place said model within a greater sphere of operational understanding becomes an additive benefit. Being able to operationalize maintenance, traffic flows, upkeep processes based on modeled situations captured either asynchronously or real-time encourages better custodial care and spend based around functional gains in preservation. This can be applied, especially in a hyperconnected space like Iceland, to almost limitless applications across geological, topologic, historical, and culturally significant sites.

Discussion

Generative AI is a means to an end for many organizations. It offers the low-hanging fruit of approachability while allowing the generation of new and exciting methods of communication. At its heart, however, is the very real and extant data that it represents and consequently synthesizes. There are inevitable collisions in such cases: adulterated provenance, custodial relationships, appropriation, privacy, and so on. Without careful though or means of access, there is a very real risk of creating alternative stories without an underpinning of veracity.

Cultures run the risk, as these generative technologies continue to become mainstream, of losing unique and interesting cultural attributes, especially given the synthetic nature of diffusion-based or large language models. To enable accurate preservation while simultaneously allowing the accessibility and ease of use that these models portend, creating useful tools and processes to harness appropriate usage while minimizing friction becomes paramount. Further, the need to develop novel methods of income for sustaining these cultural assets promulgates the idea that using emerging technologies such as generative AI can, and will, harness the unique and interesting to the plow of capital progression.

The ideology presented here is not outside the realm of plausibility and is certainly something that is practically being done in disparate ways today. Offered here is a nascent process for future technological anthropology that serves to preserve culture, without giving up the inherent beauty and provenance of heritage and place. This is just one of any number of extant places where generative AI could be used, and this example provides a very tactile representation of a

culture maintaining identity in a digital space.

Footnotes

[1] Comparisons will inevitably be made to the concept of a non-fungible token (NFT). The asset could certainly be persisted as an NFT as a means of output for usage within systems like Unreal Engine. This becomes an intrinsic part of the dissemination process highlighted later in this document.

[2] https://en.minjastofnun.is/