Background WP T4

A Virtual Museum Without Walls (VMWW) was developed as part of workpackage T4. It provides easy to use interfaces that enable community engagement and SME participation in the creation, curation and management of digital exhibitions. It integrates the treatment of spherical, 3D and other audio visual data enabling the creation of virtual and mixed reality exhibitions. It enables data to be curated and reused within multiple use cases and supports the creation of location aware applications. It supports live virtual tours and smart tourism. In realising these objectives we addressed the following issues:

1) The creation and capture of digital scenes, artefacts and narratives.
2) The ingestion of data and its associated meta data.
3) The archiving of data and associated meta data within digital repositories.
4) The augmentation of physical exhibits and the creation of virtual exhibits.
5) Support for the intuitive curation of exhibitions by domain experts.
6) Support for digital resources to be reused across multiple use cases.
7) Support for live interactive virtual tours.

The system is engineered to ensure user quality of experience. We created toolkits and organised training to empower SMEs, museum staff and community members to create digital objects, spherical media and digital scenes. We developed a application profiles to define metadata and provide a simple ingestion mechanism through form upload. The data archive system associates source materials with items, e.g. a spherical image can be associated with its source images. The VMWW uses and extends OMEKA to support the creation of mobile apps, web exhibitions, museum installations, virtual and cross reality apps as well as map, social media and wiki interfaces.

Transferability

The VMW2 was made using open source components and software. It uses open standards. This protects against software being discontinued or changes in proprietry software. Digital content has been released and made available under Creative Commons licenses. The VMW2 is connected to the Internet enabling content and systems to be available to organisations and individuals across the region. The VMW2 archive associates sources with digital items, enabling them to be rebuilt for new formats and platforms.

Durability

During the lifetime partners will make use of the VMW2. This will enable the systems to be tested and embedded in the organisations workflows. The provision of a package for local standalone installation, will be taken forward as a product available from all partner institutions. Use of the VMW2 as a service. Point and click user interfaces will enable the creation of applications. This ease of use will enable widespread adoption of the product. Output will be a fully featured virtual museum, available as a combined hardware software package available in configurations suitable for community groups, museums large and small and small to medium enterprises. The museum will be hosted on dual redundant servers based at the University of St Andrews in temperature and power

regulated green machine room. The servers will be maintained live for a minimum of five years after the project. Self help guides will make it easy to engage with project software, media and data. Meta data that conforms with or maps to Internet, ICOM and Europeana standards will provide context

Target Groups

We worked with the two partner SMEs to develop the VMW2 so that it lowers the technology barrier for SMEs to engage with mobile and immersive technologies. We adopted a process based approach to research. We reflected on and measured the technologies we create, with particular respect to user engagement, user experience and system quality of service. We wrote and presented papers about our work to engage with higher education and research. An essential component of the virtual museum is the development of and support for digitization, archiving and dissemination of digital artefacts, digital scenes and related media. We held workshops in parallel with partner meetings in each country. These equiped partners to engage with: the general public, schools and SMEs as well as education and training centres.

Through supporting the creation of Virtual Tours, Location based apps, museum installations and Web Virtual Musuems we enabled access to digital media through mobile devices and the Internet. In this way we reached both the general public and target groups across the whole region. Target groups include: local public authority, regional public authority, national public authority, sectoral agency, higher education and research, education/training centre and school, SMEs, business support organisation and the General public.

Trans-national Collaboration

The work package has been lead by the team from the University of St Andrews including Alan Miller, Sarah Kennedy, Catherine Anne Cassidy, Iain Oliver and Bess Rhodes with participations and support from all project partners and beyond. Contributions include interface design from Anna Vermehren (Museum Nord), meta data design Johanna Clements (TS), Mobile Apps, Mapping and Games Skuli Björn Gunnarson and Skota (GST), Location apps (LOC), videos, images and digital modelling (AB), digital reconstructions Jacquie Aitken from (TS), community heritage guides, reconstructions and digital content Niall McShane (UU) and Situated Simulation (IMK). Of course many other organisations and people have contributed as can be seen in the content.

Figure 1 Digital Heritage, Archaeologicl Reconstructions and the Curatorial field featured on CINEGATE ***https://www.youtube.com/watch?v=CBb2koyu0dU***

OT 4.1.2. Output Evidence

The Virtual Museum Infrastructure and Toolkit has Galleries, Archives, Toolkits and Exhibition (GATE). It showcases the achievements of the CINE project. There are galleries of 3D objects, Virtual Tours, Interactive Maps, historic simulations, mobile apps, live heritage events and reflective discussions. Through CINEGATE we connect with Social Archive sites like Vimeo, Youtube, share to Social media sites like Facebook and Twitter, support live events promoting Heritage at Home and deliver "Museum at Home" experiences.

Virtual Museum Infrastructure and Toolkit is

1. an infrastructure to support the creation of virtual museums,
2. a toolkit of digital outputs,
3. the CINE virtual museum CINEGATE.

All content is accessible via cineg.org.

The VMI is described as an "infrastructure" because it is extensible and provides support for organisations to create their own archives, galleries, maps and exhibitions.
It contains the following features:

- It is an archive which holds data and metadata about cultural and natural heritage.
- it allows organisations or individuals to create accounts, to log-in and create their own resource repository. Content can then be seen in the VMI directly, embedded in web pages shared through social media.
- it allows content to be viewed through the International Image Interoperability Framework (IIIF), digital galleries, interactive maps and virtual timelines.
- it provides services which enable heritage organisations to connect with community and visitors at homes.
- it contains services for automated processing of images into 3D models, live guided collective distributed exploration of digital reconstructions and tools for creating VR Exhibits and Apps
- it connects with the EU Zenodo archive system, and with social media accounts. It is Europeana ready.

CINEGATE as a virtual museum for CINE includes digital galleries of 3D artefacts from the National Museum of Iceland, digital reconstructions of the case study sites, virtual time travel media (content for the Digitourist toolkit), workshop content and interactive maps connecting with rich media, among others. The VMI is available as a package to install. This allows organisations to set up their own VMIs and networks of VMIs. This facility has been used to set up galleries for organisations like The West Highland Museum, the CUPIDO North Sea Region INTERREG project and the Scottish Civic Forum to provide digital suppot for Doors Open days.

Figure 2 This image embedded on Google Maps has recieved 277k views during CINE

OT 4.1.2 Output Indicators

Number of solutions (services) for the sustainable management of natural and cultural heritage (specific): target 8, achieved 9

Through this work millions of people have been touched. One photograph of the Vágar site on Google Street View has been seen 277k times, over 126 3D models (objects) have been digitised and archived in CINEGATE with 4.5k downloads. Live heritage events events featuring digital reconstructions and have reached over 400,000 people. For 4.1.2 the specific output indicator is the number of solutions (services) for the sustainable management of natural and cultural heritage (specific).

1. CINE GATE established, period 1
2. Thanes mapping facility, period 2
3. Metadata upload compatible with Europeana, period 3
4. Virtual trail app framework, period 3
5. CINE GATE digitization tools, period 3
6. Virtual exhibition toolkit, period 3
7. Muninn App for recording heritage sites, period 4
8. CINE Auto Photogrammetry Service CAPS, period 6
9. CINE IIIF Gallery Service, period 6

CINE GATE, period 1

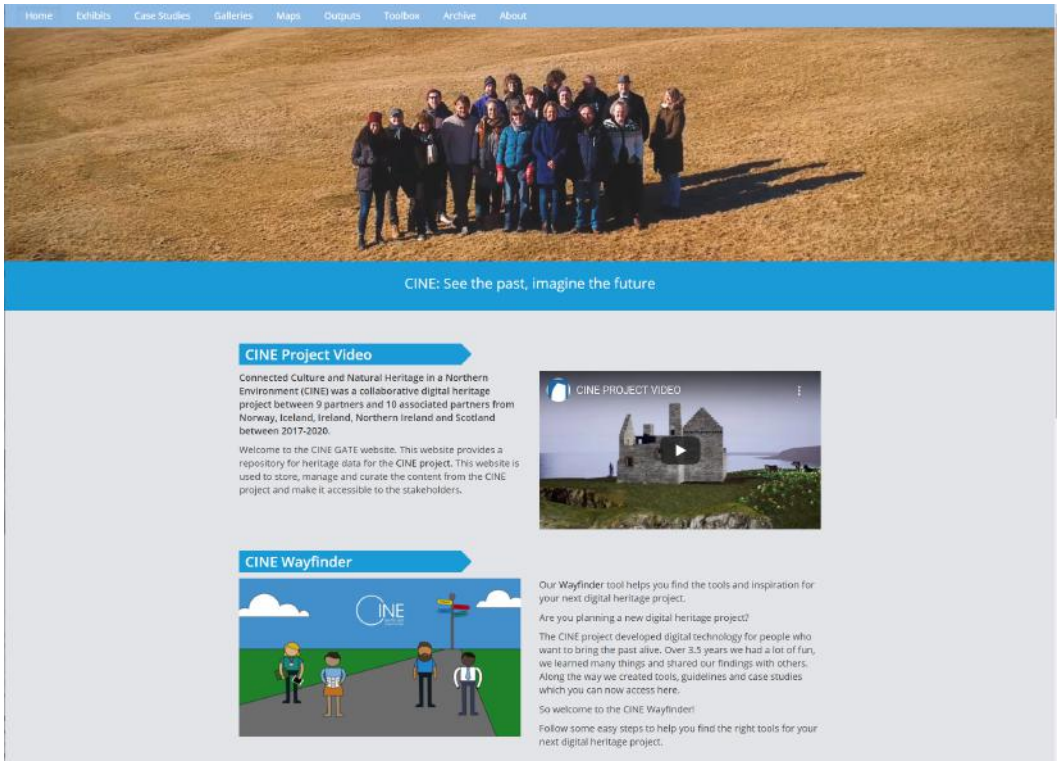


Figure 3 Frontpage from CINEGATE, highlighting the CINE project video and CINE Wayfinder.

The CINE Galleries Archives Toolkits and Exhibits was established in period one of the CINE project. It is a repository for digital outputs from CINE. A front page introduces the project, providing context, together with highlights, links to project social media and the project website. The rest of the site is:

1) Exhibits, which highlight curated content from the project such as Live! Heritage at Home events featuring digital reconstruction, the program of CINE Talks addressing heritage themes, as well as featured, maps, apps and galleries.
2) A landing page for each of the five project case studies of Vagar, Killybegs, Inch Island, Strath of Kildonan and Skriduklauster, with links to relevant websites, galleries and content.
3) Galleries: The Galleries page provides access to digital representations of heritage organized by theme, location or media. Each item is accompanied by meta data consistent with Dublin Core Metadata Initiative (DCMI) application profiles. The galleries use and extend the International Image Interoperability Framework (IIIF).
4) A Maps page features interactive maps showing heritage subjects such as project partners, archaeological sites, trade routes and community participation. This brings together leaflet and openstreet view and connects them to the archive system.
5) A page brings together and provides access to a summary of the CINE Outputs from each of the four technical work packages:
6) CINE Toolkits: provides access to a collection of toolkits created in the CINE project. These toolkits broadly provide support for the digital preservation and promotion of heritage.

There is a user system which is part of CINEGATE. This enables users to create accounts and associate themselves with an organisation in the system. Once a user is registered, they can then login to the system and make use of the CINEGATE resources.

Metadata, provides context for heritage items, makes them discoverable and accessible. There are six metadata profiles for real world categories one each for organisations, events, collections, immovable heritage, movable heritage and intangible heritage. There is a separate profile for digital representations of heritage. This includes media, digital models and digital reconstructions. As well as describing the item it gives information about how the media, how it is to be managed and licensed. Visual Interfaces are provided for the following operations:

1) UPLOAD: Upload forms which enable heritage items to be defined, uploaded and for media to be associated with them
2) EDIT: Forms for editing and saving existing metadata and associations
3) SEARCH: Support for searching for text strings within the meta data of resources
4) LAYERS: Support for associating items in the system into layers. These layers can be used to make galleries, maps and narratives.
5) GALLERIES: each gallery consists of one or more layer. The galleries present media together with the metadata associated with that media. They also provide progressive download and manipulation of the media. Galleries can be shared to social media and embedded into web sites.
6) MAPS: interfaces to define the initial bounds of a map together with key, text and layers to make a map. The map has hotspots defined which then, link to media, and galleries. Maps can be shared to social media and embedded in web pages.

Digital narratives can be constructed through a WordPress service, that CINEGATE provides enabling the creation of sites, and connecting those sites to content held within CINEGAATES archive.

The functionality of CINEGATE was created by connecting together opensource software components. At the heart is Omeka which “provides open-source web publishing platforms for sharing digital collections and creating media-rich online exhibits.” This is paired with a mySQL data base, which provides archiving system, IIIF provides a digital gallery system whilst leaflet and Open Street Maps form the core of the mapping system. These are connected through bespoke code, which provides login and forms-based resource management.

The CINEGATE was created at the start of the project and was used as a repository for sharing resources. It was then developed into a platform for showcasing the work of the project and will be maintained as a service for at least five years after the end of the project. The CINEGATE codebase and systems have been packaged into a repository, which can be downloaded and installed enabling it to be used to create new Virtual Museum infrastructure, for individual virtual museums or for networks of virtual museums.

Evidence

The live instantiation of the Virtual Museum Infrastructure CINEGATE is located at www.cineg.org. The menu system provides access to reconstructions, galleries, maps and the archive system.

Thanes mapping facility, period 2

The spatial representation of heritage data, through maps and mapping has provided a valuable way of visualising the distribution of that data, enabling us to understand it better. In the digital domain the capability of linking hotspots on maps to rich media, adds a new and valuable dimension to mapping heritage.

The Thanes mapping facility consists of three main components.

1) The underlying archive, metadata and layering system.
2) A heritage mapping service that supoports the creation of standalone maps.
3) A CINE Street View account with support for uploading to Street View from CINEG

CINE Heritage Open Mapping Service (CHOMS)

The CINE Heritage Mapping Service (CHOMS) is a system for creating interactive maps with heritage, media and metadata archived within the CINEG system. To make a map, there are three stages:

1) Upload or link heritage, media and associated metadata to CINEG or identify items already in CINEG.
2) Create a layer in CINEG.
3) Create a map and associate a layer to the map.

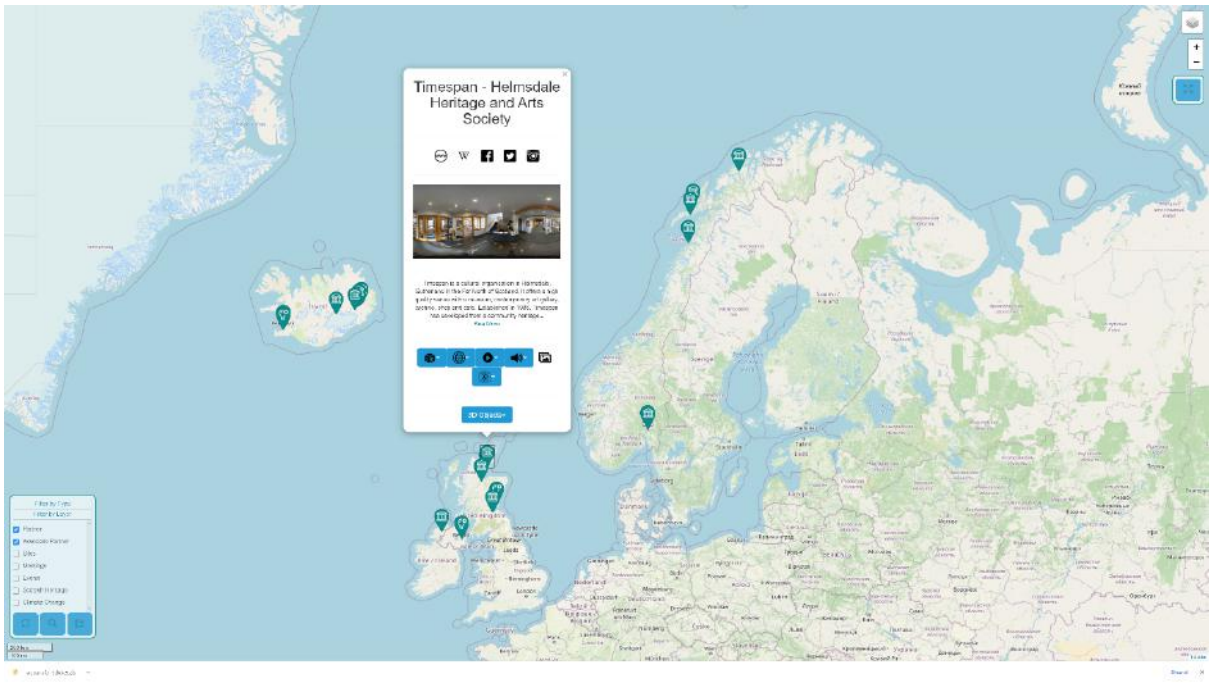
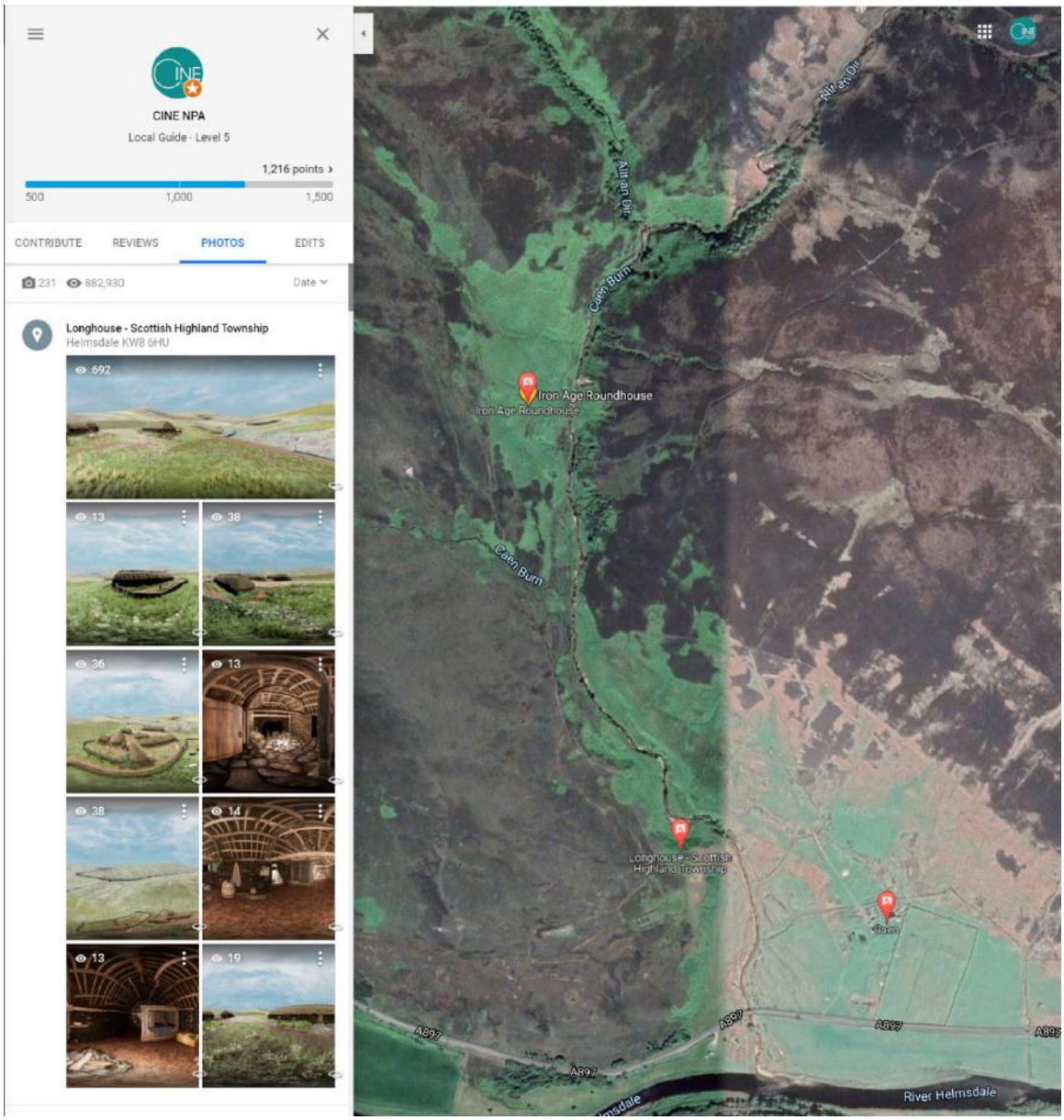


Figure 4 Interactive Map of CINE Partners and Associate Partners. https://cineg.org/map-page/?itemid=1

A key, introductory text, image and video can also be added. A simple map may have only one layer. However a map may contain multiple layers. In which case a default configuration

will define, which layers are visible when the map is loaded. A menu in the map enables each layer to be switched on or off, allowing the user to control presentation.

The map may have points, paths and shapes represented on it. Each point, path or shape



represents a piece of heritage. It may have connected with it a title, description and image. Which will appear in a pop up when clicked on. The underlying maps base is provided gy open street maps and may be a schematic or satellite view. The framework for presentation and application programing interface used is Leaflet. These open source libraries mean that the mapping system is extensible and also connects with existing communities.

The CHOMS system has been developed primarily by University of St Andrews in collaboration with Gunnar Gunnarson Institute. It has been used to make maps for project case studies as well as by several heritage organisations (Finlaggan Trust, Timespan Museum, Tomintoul Discovery Centre).

CINE Street View Support (CSVS)

The THANES mapping facility provides support for connecting with and using Google Street View and Google Maps to represent to connect with their users with heritage and heritage organisations. Users can upload images and photospheres, arrange them into tours, write reviews, create lists and create custom maps.

The CINE Street View account, has 231 photos with 882,830 views. These include photospheres of digital reconstructions in Iceland, Ireland, Norway and Scotland as well as numerous photospheres of present day heritage sites and museums.

Collections include: Longhouse Reconstruction, Iron Age Roundhouse, Helmsdale in the Herring boom and Skriduklauster. One photosphere from the Vagar site has received 277,189 views.

CINE provides support for using Google Street View and Google Maps, by providing archives for photospheres and enabling them to be uploaded to the CINE Google Street View Account.

Evidence

Virtual Museum Mapping: https://cineg.org/one-page-express/maps/

CINE Google Maps Account:
https://www.google.co.uk/maps/contrib/101110365033495350964/photos/

Metadata upload compatible with Europeana, period 3

The Upload, Metadata, Archiving and Sharing facilities in CINEGATE, provide support for creating, archiving and sharing meta data and content associated with heritage. These facilities are accessed through the Archive Page in CINEGATE. A user system controls provides authentication and authorisation service, which controls access and enables resources to be allocated to users and their organisations. All meta data in CINEGATE is in the public domain.

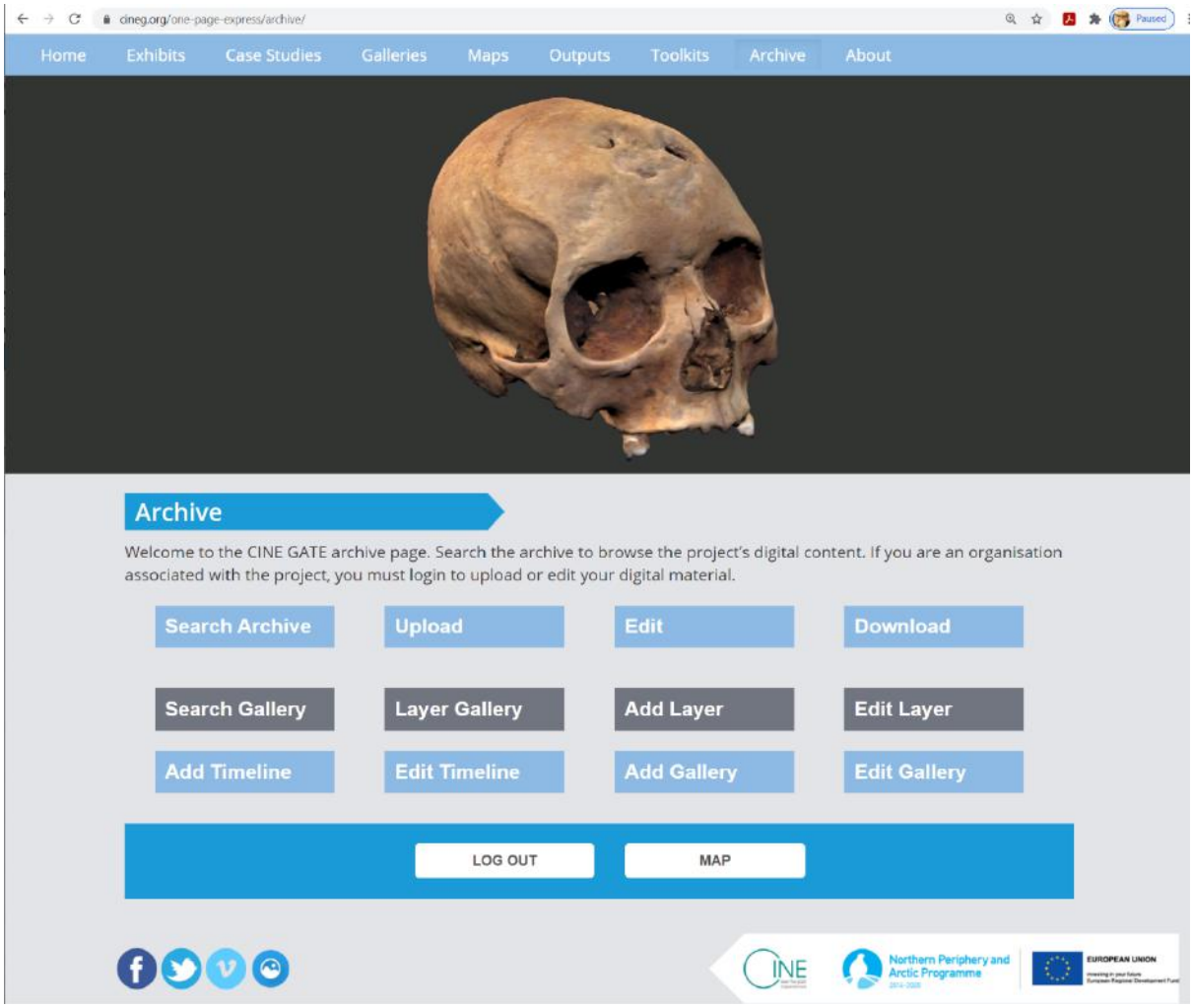


Figure 5 CINEGATE Archive Page

In the CINE project and as part of the Virtual Museum infrastructure and toolkit we have defined separate meta data profiles for real world heritage types and for digital representations. The goal was to define a meta data system which provides coverage for diverse types of heritage and is accessible for use by volunteers as well as professionals. We made use of open standards associated with the Dublin Core Meta Data initiative and tried to limit the complexity of the schemas developed.

UNESCO provides definition of the types of Cultural Heritage as:
*The term cu*ltural heritage encompasses several main categories of heritage
Cultural heritage

- *Tangible cultural heritage:*
  - *movable cultural heritage (paintings, sculptures, coins, manuscripts)*
  - *immovable cultural heritage (monuments, archaeological sites, and so on)*

- *underwater cultural heritage (shipwrecks, underwater ruins and cities)*
- *Intangible cultural heritage: oral traditions, performing arts, rituals"*

http://www.unesco.org/new/en/culture/themes/illicit-trafficking-of-cultural-property/unesco-database-of-national-cultural-heritage-laws/frequently-asked-questions/definition-of-the-cultural-heritage/"

Following this we define three types of Cultural Heritage, Movable, Immovable and Intangible and have developed metadata application profiles for each of these. Underwater, and Natural Heritage are both treated as subcategories within the Movable, Immovable and Intangible categories giving us the following taxonomy:

1) Movable Heritage: Cultural, Natural
2) Immovable Cultural Heritage: Cultural, Natural
3) Intangible Cultural Heritage: Cultural, Natural

The form for Movable heritage is accessible here https://cineg.org/galleries/addtangible.php and reproduced below. The Metadata is defined using the Dublin Core Meta Data Initiative (DCMI) element set defined in Request for Comments document rfc2413 (https://www.ietf.org/rfc/rfc5013.txt). The metadata describing the heritage consists of the following fields:

Table 1 Metadata profilfe for descibing movable heritage items

Name	**Description**	**DCMI Type**
Title	The name given to the the resource usually by the creator	Title
Subject	The topic of the resource.	Subject and Keywords
Tags	The topic of the resource.	Subject and keywords
Description	A textual description of the content of the resource	Description
Maker	The person, organisation of culture responsible for creating the resource	Author or Creator
Creation Date	The date, period or era the resource was created	Coverage
Material	What the resource was made out of	Description
Source	Information about a second resource from which the first is derived.	Source
References	Another resource that is related and the relations	Relation
Size	The dimesnsions of the resource	Format
Language	The language of the intellectual content (if any) of the resource	Language
Current Location	Where the resource was found	Coverage
Original Location	Where the resource was created	Coverage
Find Location	Where the resource was found	Coverage

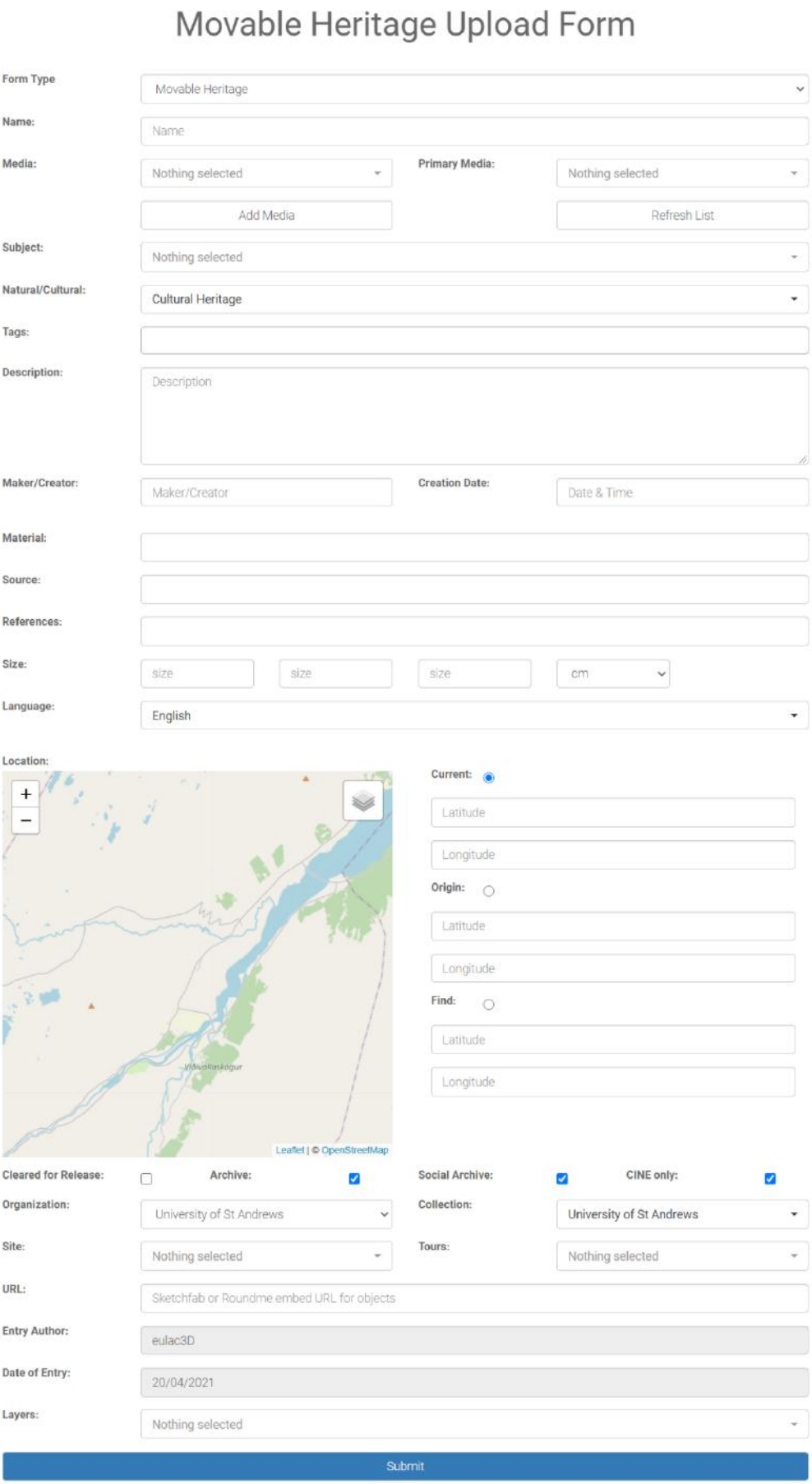


Figure 6 Movable (artefact) heritage upload form for describing heritage items

Additional to the fields describing the heritage are fields which enable the resource to be managed such as: Organisation: the organisation responsible for managing the resources. Layer, Collection, Tours and Site all aggregates to which the resource may belong. Additional media may be associated with the heritage and a specific piece of media nominated as prime. A record of the person who up0loaded and date of upload is also taken. Metadata may be entered by typing in text boxes, selecting from lists or clicking on the map.

There is a similar form for Immovable Heritage and Intangible Heritage. No fields are compulsory, although practically a minimum of title, date and location is strongly recommended.

Collections
Up until now we have considered meta data directly describing different types of heritage. However, there are two related types of things that the system handles. The first is aggregations. Things that contain or are related to multiple items of heritage: these are Organisations, Sites, Events and Collections.

Media
In the digital domain we don't interact directly with heritage places, artefacts, or events rather we interact with digital representations of them. These may be photographs, audio, video, 3D models, spherical media, digital scenes or take some other form. There is a distinction between a piece of heritage and the digital representation of it. There may be a physical building, archaeological site or monument, which are physical immovable heritage sites and media representations, photos, video, digital reconstructions which are linked to, represent but are distinct from the real-world heritage. For this reason, we have separate metadata application profiles for media.

The metadata used to describe media representing heritage is:

Label	Description	DCMI type
Name	Name given to the resource.	Title
Description	A textual description of the media.	Description
Type	Image, Video, 3D, Reconstruction etc.	Resource Type
Format	The format of the media.	Format
Media Creator	The person or organisation that made the media.	Author or Creator
License	The license the media is available to third parties under.	Rights Management
Date Created	The data the media was created.	Coverage
Subject	The chosen topic of the media	Subject and ?Keywords
Tags	Supplied keywords for the media.	Subject and Keywords
Location	The place the media is about.	Coverage

The archive and the metadata support established and emergent media types including audio and images, fixed and moving, flat and spherical, mono and stereoscopic media. It also supports reconstructions and simulations. There is also metadata which enables media to be associated with one or more items, collections and layers within the system, controls who can see the media and enables it to be shared to social media sites and aggregators.

Public Repositories and Aggregators for Data and Meta Data

One of the strengths of working with digital representations of heritage is that it is easy to reach across the globe and to make multiple copies. The CINEGATE system has been designed to make the most of this by making it easy to share content and metadata from the archive to social media, web sites and with public repositories.

Zenodo

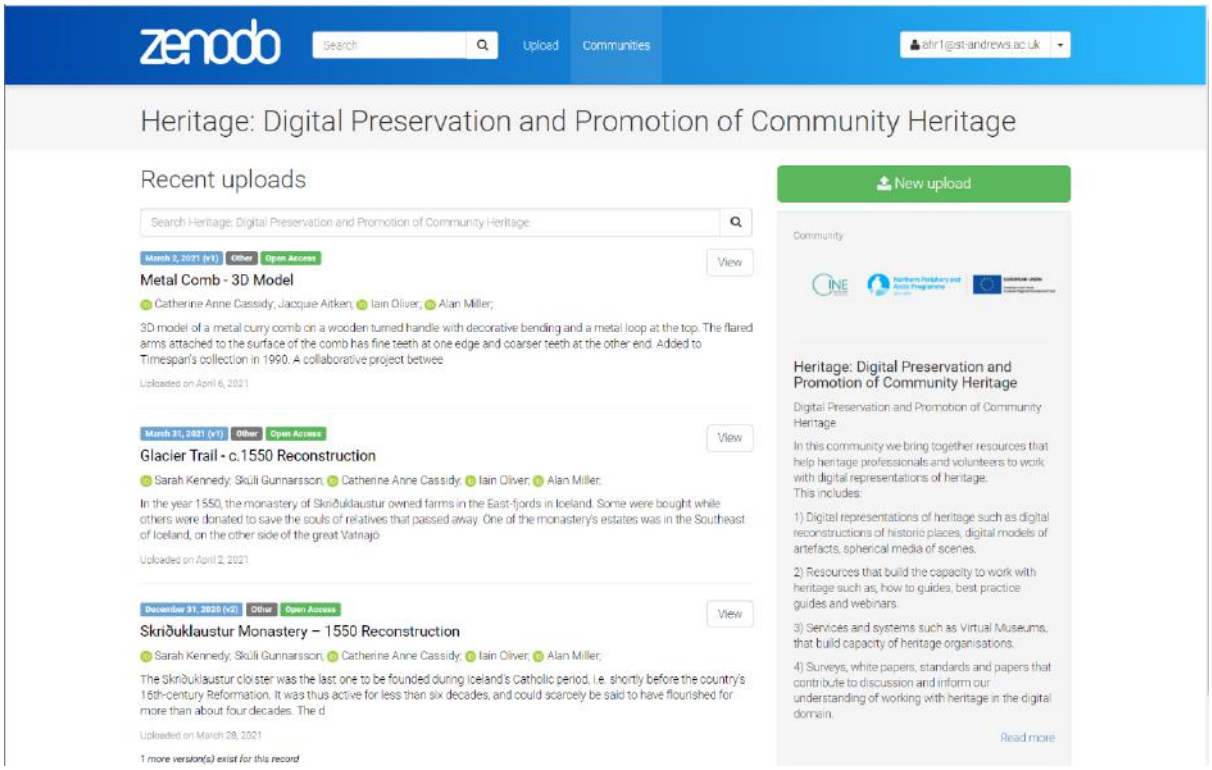


Figure 7 Digital Preservation and Promotion of Heritage Community in the ZENODO public archive

Zenodo is a general-purpose open access repository, developed as part of the European OpenAir program. It is operated at CERN and provides support for research papers, data sets, research software, reports, and any other research related digital artifacts. Submissions are archived by Zenodo, made available for download and each submission is allocated a persistent digital object identifier (DOI), which makes it easy to find stored items. (https://en.wikipedia.org/wiki/Zenodo).

We have created a CINE account for ZENODO and linked to it from the CINEGATE Archive. Items in archive can be pushed to ZENODO and made available for download and citation in this well-known EU repository. Archive is guaranteed for 10 years.

There is also the capability to make ZENODO communities. Any user can submit to or subscribe toa ZENODO community. This provides a collaborative community that is open for new contributions. We have created a specific community which is titled: and described:

Heritage: Digital Preservation and Promotion of Community Heritage.

In this community we bring together resources that help heritage professionals and volunteers to work with digital representations of heritage. This includes:

1) Digital representations of heritage such as digital reconstructions of historic places, digital models of artefacts, spherical media of scenes.

2) Resources that build the capacity to work with heritage such as, how to guides, best practice guides and webinars.

3) Services and systems such as Virtual Museums, that build capacity of heritage organisations.

4) Surveys, white papers, standards and papers that contribute to discussion and inform our understanding of working with heritage in the digital domain.

Currently there are 35 items for download in the community. These include Digital Reconstructions, Reports, 3D digital models, interactive maps and digital galleries. The community will continue to grow to reflect the totality of CINE outputs as well as wider work in digital heritage.

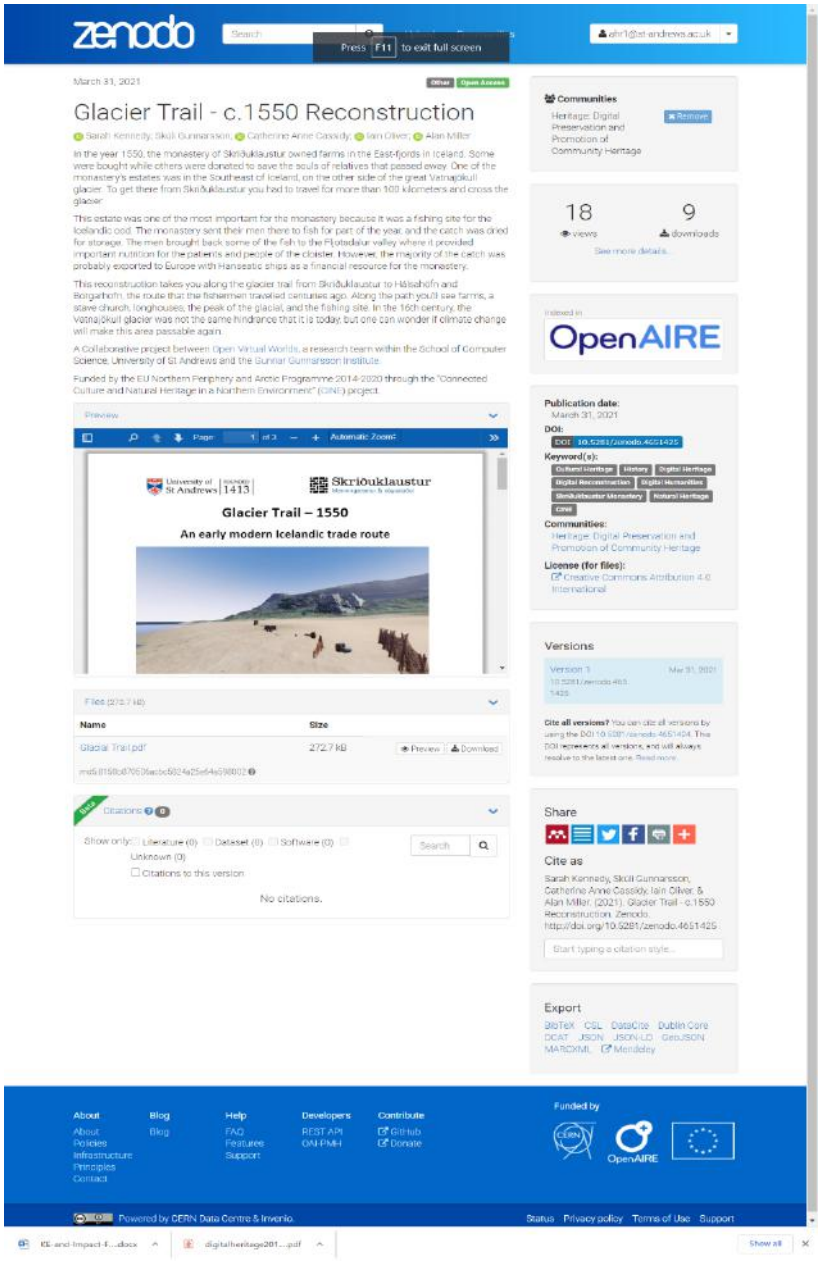


Figure 8 Iceland Glacier Trail entry in ZENODO: https://zenodo.org/record/4651425#.YH7VFOhKhWI

The 1550 reconstruction of the Icelandic Glacial Trail is registered in Zenodo. It contains a project descripti on as well as a pdf with links to the reconstruction and virtual tours made from the reconstructions. There is also a DOI, which enables the trail to be located and cited.

DOI 10.5281/zenodo.4651425

Europeana

Europeana is the EU's Virtual Museum. It contains digital representations of cultural heritage from Europe's museums, galleries, historic buildings and archaeological sites.

Europeana brings together digital representations of heritage from many different sites. This poses the challenge of how to aggregate together data, which is described by a variety of different meta data schemas. This is a significant challenge (https://pro.europeana.eu/share-your-data/metadata), which involves both the definition of a common standard "The European Data Model" and processes for converting from multiple different standards to the EDM.

The adoption of CINEG of separate meta data for real world and digital representations of data aligns with the EDM structure of separate forms to describe the real and digital representations of heritage. This makes it easier to translate from CINEG internal representations of metadata to the European Data Model (EDM). The process we have adopted is to use the "Open Archives Initiative Protocol for Metadata harvesting". https://www.openarchives.org/pmh/. The CINEG Omeka backend has the OAI-PMH repository plugin installed and configured. This can output several formats which other systems can harvest. The base URL for the OAI-PMH repository is at: https://cineg.org/omeka/oai-pmh-repository/request. The OAI-PMI plugin translates meta data into the omeka-xml format.

UStA has joined CARARE and is in the process of uploading to Europeana. CARARE is a certified aggregator for Europeana focussed on archaeological content. This means that museums, other heritage organisations and projects upload their meta data and content to CARARE and from their it is uploaded to Europeana. A service called the CARARE MINT mapping system, takes Omeka-xml that and converts it into EDM format which EUROPEANA can ingest. There is a guide to using CARARE's MINT system which is available at https://carare.gitbook.io/mint-mapping-service/getting-started.

CARARE are an accredited Europeana aggregator. Once data is loaded into the CARARE MINT instance it is loaded into their MORe system and it is then ready to be harvested by EUOPEANA.

Summary

We have discussed in some detail the CINEG metadata and archive system. This supports volunteers and professionals in archiving meta data about heritage and digital content. This includes the ability to associate metadata with heritage items and linked but separately, with digital representations of that heritage.
The CINEG system supports the export of meta data and content to the Zenodo EU archiving system and to the European Virtual Museum Europeana. These facilities provide the core functionality for the archiving, preserving and promoting cultural and natural heritage

Evidence

CINEGATE Archive page: https://cineg.org/one-page-express/archive/

Zenodo: Heritage and Preservation Archive: https://zenodo.org/communities/heritage/

Virtual trail app framework, period 3

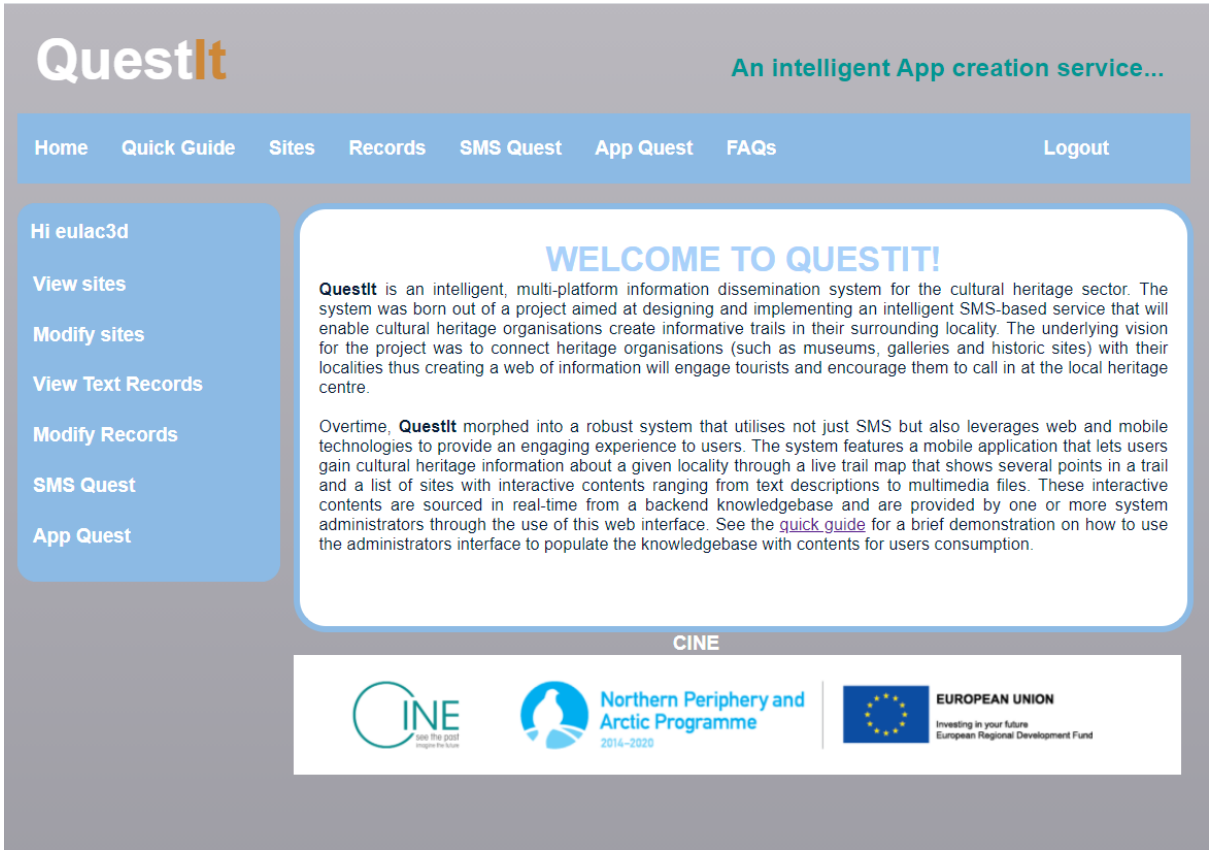


Figure 9 QuestIt trail app framework: https://cineg.org/questit/admin/home.php

In CINEAGATE there is support for two app creation frameworks:

1) QuestIt, provides a framework for creating digital trail apps.
2) Smart spheres provide a framework for immersive cross reality apps.

4.1 QuestIt trail app framework

Trail Apps provide a way that museums and other heritage organisations can connect with visitors who are travelling through their hinterlands. However, commissioning a trail app may be a mystical and expensive option involving engagement with technical specialists.
There are many features of trail apps that are similar, this suggests that it is possible to create a Trail App Framework, which can be used by heritage professionals and volunteers to create trail apps by focusing on the heritage content that goes into the app, whilst the framework means that code development is not required.
Quest It started as a master's project in the School of Computer Science, originally intended as text-based messaging tourist guide, it was developed into a full-blown framework for creating trail apps and has been connected to CINEGATE.

*"**QuestIt** is an intelligent, multi-platform information dissemination system for the cultural heritage sector. The system was born out of a project aimed at designing and implementing an intelligent SMS-based service that will enable cultural heritage organisations create informative trails in their surrounding locality. The underlying vision for the project was to connect heritage organisations (such as museums, galleries and historic sites) with their*

localities thus creating a web of information will engage tourists and encourage them to call in at the local heritage centre."

To use QuestIt to make an app, you need to log into the system. This provides two interfaces one for editing the app and the second for viewing the app content as it is developed. The process of using

The format supported by QuestIt is straightforward.
Questit to help make a site is
Stage 1 request an account and a Quest It Instance.
Stage 2 add app icon, text and map to QuestIt.
Stage 2 add sites to your instance
- Set a location
- Choose the type of site
- Add text
- Add media

Stage 3 Sites can be interatively reviewed, edited and deleted from the management interface, until the app is complet
Stage 4 A web representation of the app can be viewed online prior to compilation int mobile app formats.
Stage 5 The app is compiled using the Cordova App framework and configured to retrieve its data resulting in IOS and Android apps that can be downloaded and installed.

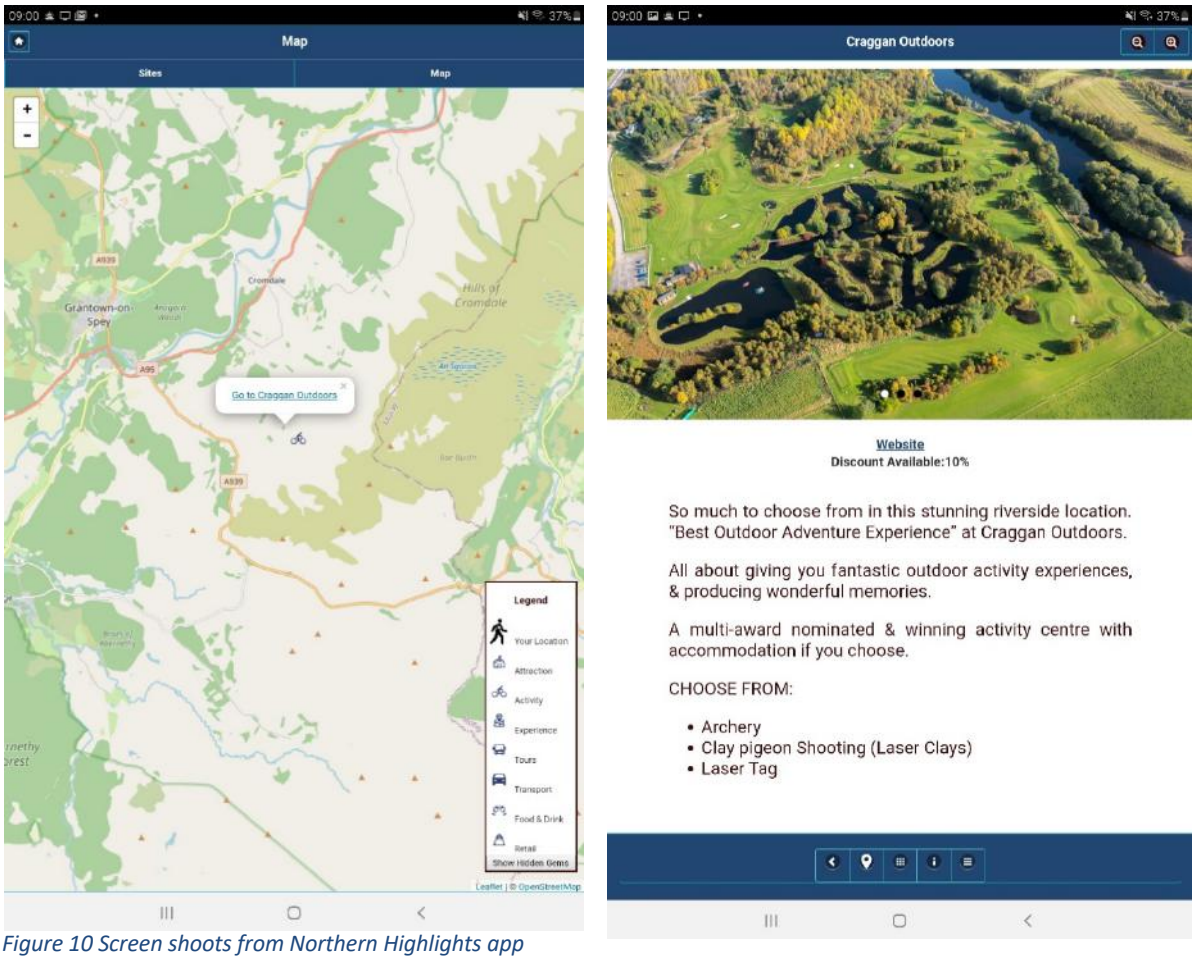


Figure 10 Screen shoots from Northern Highlights app

With this framework steps 2-4 are carried out by the heritage organisation, whilst some support is required to get the process started and finished. QuestIt provides a lightweight framework, which abstracts over the content for trail apps. This streamlines the process of app creation.

4.2 Smart Spheres

The Smart Spheres platform consists of three parts the package creation system, package management system and the app framework. The parts of this system can all have multiple implementations with the app framework currently having three.

The system creates 360 photosphere tours which can contain multiple types of media including videos, video spheres, images and audio. The visual media can all also be stereoscopic. The tours can be linear or involve navigation by a map system and navigation hotspots. It is not actually required that the tour contain any photosphere. Each media can also have loading image which is displayed whilst it is loading or for longer if set by the creator. There are hotspots for the photo and video spheres. Image hotspots for flat media and map hotspots for map navigation. The packages consist of an XML file describing the tour and the media files in a zip file.

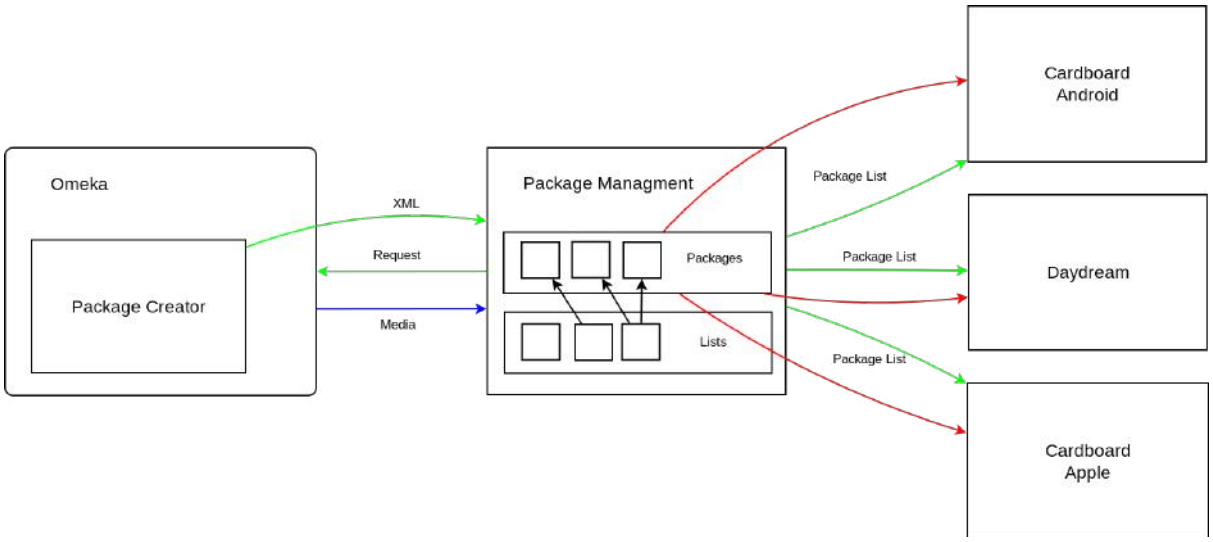


Figure 11 Smart Spheres immersive trail app framework

The package creation is done through an Omeka plug-in we have created. Omeka is a content management system for online digital collections, it provides Dublin core metadata and is easily extendable. The plug-in creates an online exhibit tour of the contents of the app. This allows the alignment of the hotspots to be checked and gives information to aid in aligning them. All of the elements of the tours are items in Omeka and nodes in the exhibit. The package system creates an XML file with URLs referring to the media files. When the package is exported to the package management system, the XML file is sent to the package management system which copies the files to a local location and adds them to a zip file and make the media references local to the zip.

The package management system controls the relationship between packages and so their content and apps. The package management system stores the packages and is used to create lists of packages for apps. These lists contain metadata about the packages including a thumbnail and last update date for the package. When a new version of an existing package is sent to the system it updates the existing package.

The app framework system takes a list of packages, downlands them and renders the packages. There are four implementations of the app framework these are: Android (Google

Cardboard), Extended Android (Google Daydream), Apple app (Google Cardboard) and Ocullus (Ocullus Go and Ocullus Quest)
The frameworks are configured with a number of parameters including the package list url and whether there are to be multiple packages or just one. Single package apps start by downloading the single package and unpacking it. The package list tells the app if the app is to downloaded automatically of require the user to requests the app is downloaded.

The apps allow two modes of interaction, VR mode or wide screen mode. In VR mode the flat media is rendered on to a plane in front of the user allowing them look around it. In the cardboard versions this allows the user to point at different parts of the image to select hotspots or map points. The daydream app uses the controller to point at those points. The spherical media render on the inside of a sphere and the hotspots are pointed at in the same way.

Strath of Kildonan Trail App.

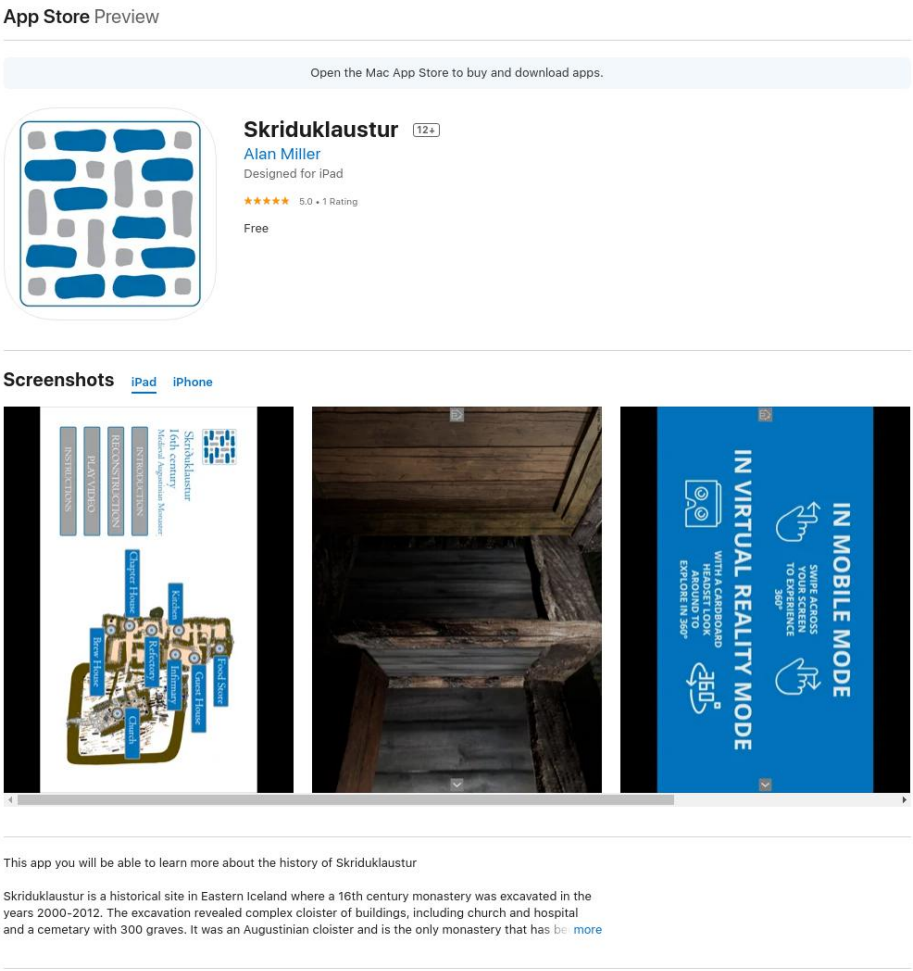
Figure 12 Strath of Kildonan Trail App

When the app is in wide screen mode the flat media is rendered on an overlay layer and hotspots are selected by touching them. The spherical media is rendered on the inside of a sphere and hotspots are selected by touching them.

The app uses OpenGL to render the media which allows them to also include 3D objects. The VR mode of the apps require that device they are used on have a Gyroscope sensor to track the orientation of the device. For the apple app framework this means that it needs the device to be and iPhone 4 or better. All daydream phones have this feature as it is a requirement of the platform. Not all Android phones have this feature.

App Deployments

The Smart Spheres framework has been used to create several apps in the CINE project and has seen wider use. In order to use it you have to login to the Omeka CINE installation. SO there is not a public user interface like there is for Questit. None the less this framework enables the development of cross reality apps using point and click interfaces, greatly reducing the investment required. We used the framework to make a CINE virtual reality showcase app, which was used to exhibit the project in Derry during an exhibition coinciding with the fourth project meeting. We have also used the framework to work with Timespan to create a Virtual Tour of the Strath of Kildonan.



Summary
The ubiquitous nature and power of mobile phones mean that they can be used by heritage organisations to deliver “Museum Without Walls” experiences. The CINE GATE system includes two frameworks for creating mobile apps. The first Questit, supports the creation of trail apps, enabling heritage professionals and volunteers to upload data into an app framework which is then compliled into an app. The second supports the creaiont of cross reality apps, that may be paired with reconstructions to provide a Virtual Time Travel experience or with real world spherical media to provide remote virtual tours.

Evidence

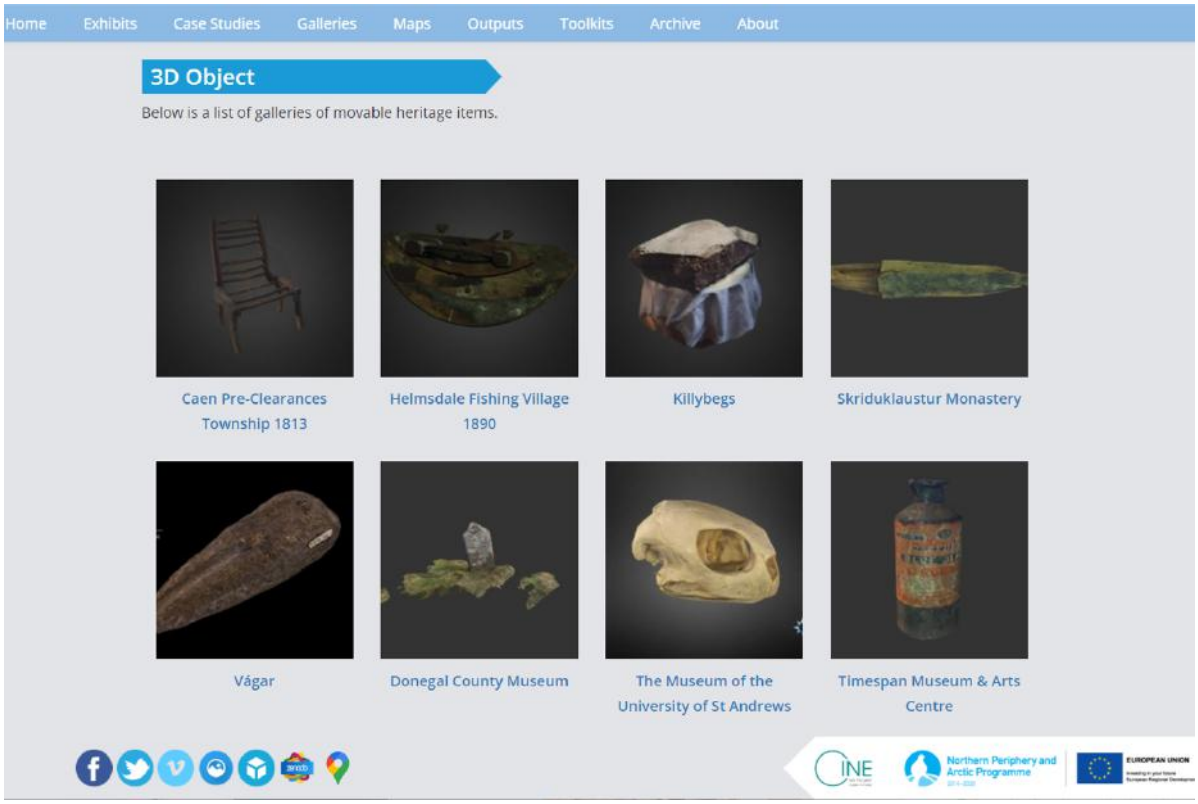
Virtual trail app framework page: *https://cineg.org/questit/admin/home.php*

CINE GATE digitisation tools, period 3

Support for digitisation of heritage focused on:

1) Using photogrammetry
2) Working with spherical media

A toolkit for both was created and hosted on CINEGATE early in the project, and underpins the considerable digitisation achievements of CINE.

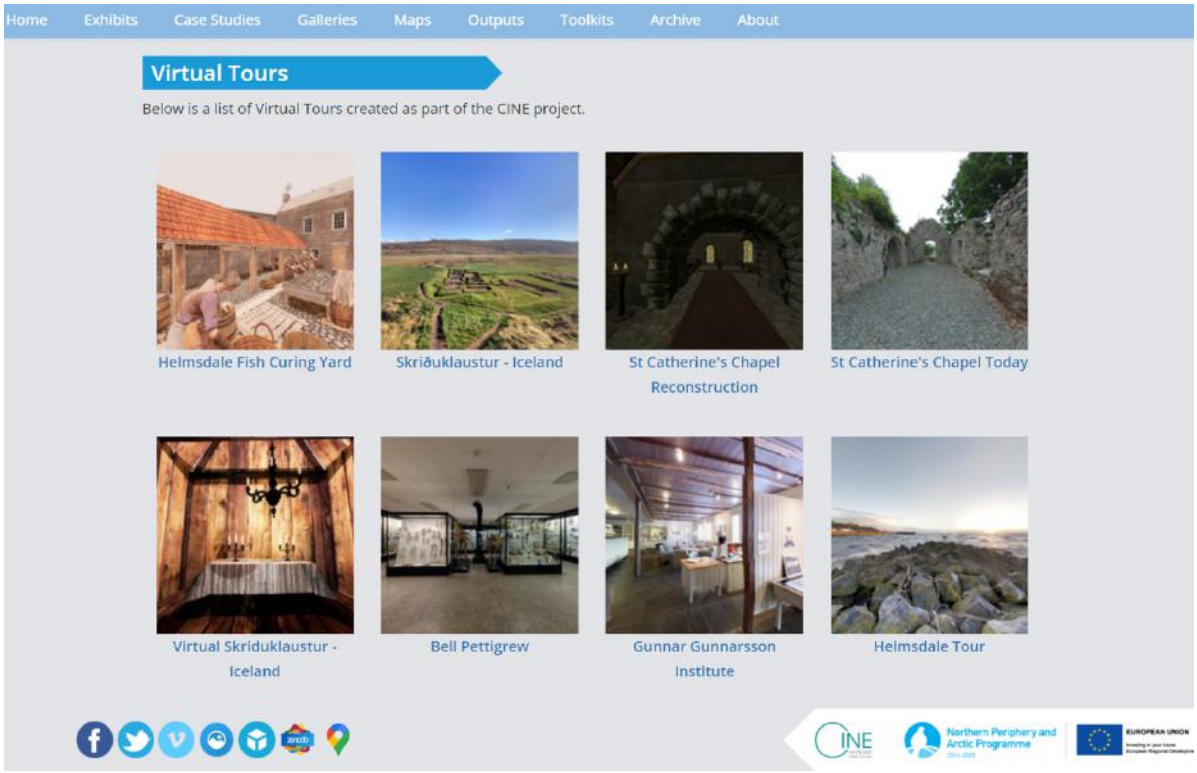


The collection of artefacts and material culture lies at the heart of many museums work in promoting cultural heritage. Yet any physical object can only be in one place at a time. This is where the digital domain offers so much. Through digitising objects, the digital representation can be easily copied, transferred, edited and manipulated.

This toolkit contains resources that help digitise objects and artefacts. We identify six stages to the process.

1. Selection of equipment
2. Selection of artefacts
3. Taking photographs
4. Creating the model
5. Archiving the data
6. Curating the results

Taken step by step each stage is not complicated to master and it is possible to get your first results in less than a day.



This toolkit contains resources and guides for creating and working with spherical media. This will enable you to create virtual tours for web, mobile and installations, which provide an immersive and engaging experience.

The guide addresses five main steps:

1. The creation of a narrative for the virtual tour.
2. The selection of appropriate equipment and software.
3. Taking photographs to be used in the tour.
4. Processing the photographs into a spherical media.
5. Archiving and meta data.
6. Creating the virtual tour.

Evidence

Link to toolkit supporting 3D digitisation: https://cineg.org/toolkits/photogrammetry/
Link to toolkit for virtual tours: https://cineg.org/toolkits/photodpheres/
Link to virtual tour galleries: https://cineg.org/360-tours-gallery/
Link to Virtual Tour Social Media: https://roundme.com/@cineg/about
Link to CINE Google maps:
https://www.google.co.uk/maps/contrib/101110365033495350964/photos/
Link to toolkit for 3D digitisation: https://cineg.org/toolkits/photogrammetry/
Link to 3D galleries: https://cineg.org/3d-objects-gallery/
Link to 3D social media: https://sketchfab.com/cineg

Virtual exhibition framework, period 3

With today's technology we can build high fidelity virtual time applications, which enable users to leverage their digital literacies to explore the past in ways that enable users to explore the past in ways that are engaging and illuminating.
This toolkit provides a template, for a virtual reality exhibit that supports multimodal presentation of the past.

The template has been developed from exhibits tested in museums and exhibitions in the North of Scotland. It has two modes of interaction. A screen or projection enables observation of the exploration. The active user puts on a headset where they are presente3d with a menu of options to choose from. They interact with the environment through combination of head tracking and a single button controller.

Hardware and software dependencies
The template requires freely available software and commodity hardware to run. The required will cost between £1000 and £2000 for a PC or could run on a top of the range laptop.

1. The template is built around UNREAL 4 level game engine, which is freely downloadable.
2. It requires a computer with a discrete graphics card, the exact specification depends on the content used and options selected. However, it will run well on commodity hardware.
3. A HD or higher display or projector
4. The third component is an Oculus Rift headset and controller.

Functionality supported by the template.
The temp late provides a menu system, which can be populated with one or more of the following types of levels.

1. A virtual time travel tour built around spherical images from a digital reconstruction combined with hotspots linked to interpretation including 3D artefacts.
2. A gallery which holds one or more plinths, together with digital 3D artefacts, and their metadata. An archive of artefacts allows collections to be explored.
3. A theatre allows videos to be viewed in a familiar setting with the benefit of an immersive headset.
4. Freeform 3D environments which users can navigate using both controller-based and Controller - free interaction techniques.

The functionality includes navigating through 3D galleries, walking around 3D environments with game controllers and/or head movements, undertaking virtual tours, and rotating 3D artefacts around multiple axes. This allows a developer to create 3D environments to download the template packs, "drag and drop" these templates into game engine levels, add content to the levels and create immersive 3D exhibits.

Evidence

The Virtual Time Travel toolkit https://cineg.org/toolkits/3d-exhibits/ contains the Virtual Exhibition Framework, which is available for download.

The framework is used in the Skriduklauster Virtual Reality exhibit, which is hosted in the Gunnar Gunnarson Institute. This features the Skriduklauster reconstruction
https://cineg.org/reconstruction-page/?itemid=1956

Muninn App for recording heritage sites, period 4

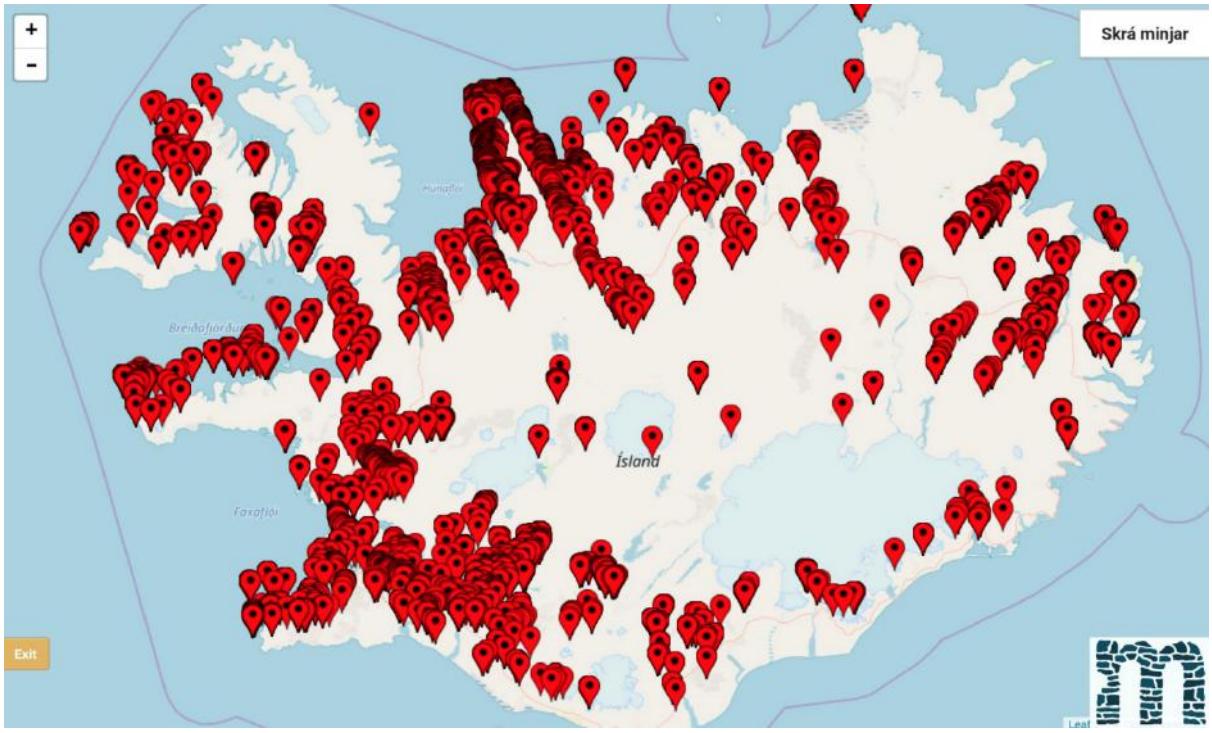


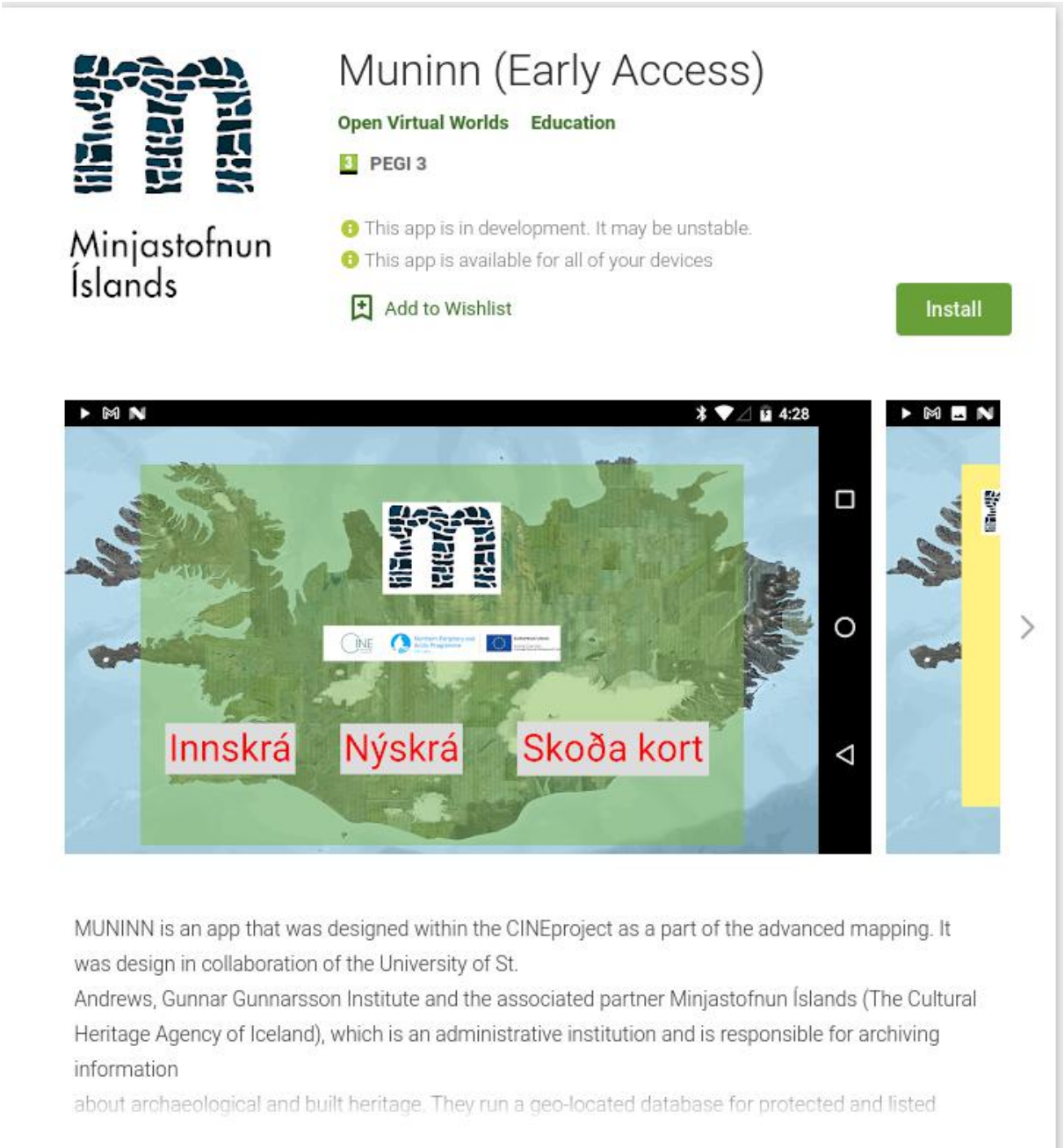
Figure 13 Muninn app supportng community archaeology reporting:
https://play.google.com/store/apps/details?id=org.cineg.minjaslodir

MUNINN is an app that was designed within the CINEproject as a part of the advanced mapping. It was design in collaboration of the University of St. Andrews, Gunnar Gunnarsson Institute and the associated partner Minjastofnun Íslands (The Cultural Heritage Agency of Iceland), which is an administrative institution and is responsible for archiving information about archaeological and built heritage. They run a geo-located database for protected and listed archaeological sites. In Iceland, each municipality is obliged to register cultural heritage within their territory as a part of their land-use and master plans. Only a part of cultural heritage in the country has been located and listed.

The idea with Muninn app is to crowdsource the act of locating cultural remains with help of the public. The information gathered via the app will go into a special database where it will be certified and made visible for
other users within the app. This can be a vital part in the process of mapping cultural heritage remains in Iceland and will serve as a source for the standardized survey done by professional archaeologists. Also, a part of the
intended usage of the app regards the monitoring of individual cultural heritage sites. The entries added in the app can help the Cultural Heritage Agency to observe sites all over the country and monitor changes e.g. impact of erosion on sites. Information recorded:

- Name of the site
- Type of remains
- Purpose of remains
- Is the site under threat
- Risk factor
- GPS-location

The user can take photo with his phone and send in with the information. The Muninn app uses the Cordova cross platform app framework. It uses a leaflet based map with clustering to show all of the map points. The app is designed to work without needing Internet access all of the time. The app stores the listings for all of the locations that are accepted into the set and any points created by the user. When the user makes a changes adding a new point or adding an image to an existing point this is stored in the app.



When the app has access to the internet it tries to send the changes that have been made by the user since it was last able to send them and the fetches a new listing of the sites stored in the backend server. This way the app can operated whilst the user is away from the Internet and send updates to be accepted or rejected by the administrator when they do have internet access. There is a user authentication system so that updates can be connected to users. Once the user has logged in, they app knows that the user has setup an identity in the system. Images are stored in the app so that they can be later sent and also so that they can be viewed whilst offline.

Evidence

Link to page, with description and download options https://cineg.org/muninn-app/

CINE Auto Photogrammetry Service (CAPS), period 6

CINE Auto Photogrammetry Service helps to digitise objects. These can be circulated widely and made accessible globally. Knowledge about heritage protects landscapes and environments. The Connected Culture and Natural Heritage in a Northern Environment (CINE), ran from 2017-2020. CINE transformed people's experiences of heritage sites and material culture, through technology, building on the idea of "museums without walls". This document describes the CINE Auto Photogrammetry Service (CAPS) a specific solution which forms part of the "Virtual Museum Infrastructure and Toolkit" and contributes to the program sustainable management of natural and cultural heritage output indicators. The CAPS supports the processing of photographs to create 3D models using structure from motion or photogrammetry.

Keywords — virtual reality, photogrammetry, museum at home (*key words****)***

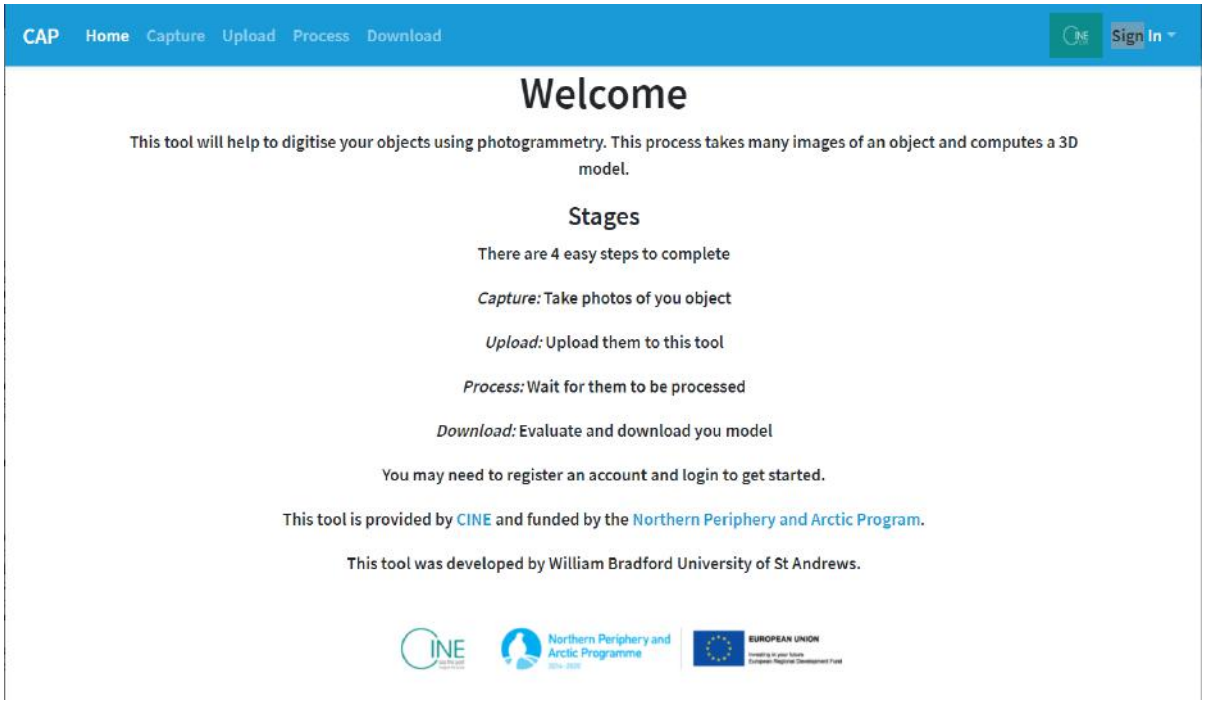


Figure 14 Start up pagfes for caps

Introduction

The impact of COVID 19 has brought home the importance of engagement with heritage for education, health, entertainment and the economy. Being able to access a museum experience from the home and engage with curated digital content has become a core part of how end users engage with heritage and how heritage organisations provide content. Over the last decade the use of digital phones has opened the possibility of using structure from motion processes to create 3D models of digital artefacts. These digital models can then play a core role in:

Providing a museum at home experience through digital galleries.

Contributing to Museum Without Walls experience by being embedded within digital reconstrcutions

Enhancing visits to museums, by creating interactive content accesible from user devices.

Through developing a Virtual Museums without Walls and a virtual museum infrastructure CINE enables museums to do just that. The idea of a Virtual Museum Infrastructure is the development of a set of resources which enables heritage professionals and volunteers to create resources which provide or contribute to a virtual museum experiences. Central to museums is the ability to engage with artefacts and objects which enable us to explore what life was like in the past.

Creating 3D digital models of heritage objects and specimens, enables multiple copies to be made and for these copies to be transported across the globe so quickly that they are effectively available anywhere, anytime basis. Digital copies can be manipulated and investigated without fear of degradation or damage. They can be enhanced without the loss of the original.

Structure from motion

Digital photography means multiple photographs of an object can be taken at very little cost. Through taking photographs from multiple orientations software is able to divine the structure of an object from multiple photographs. First creating a point cloud the result is similar to the output of laser scanners, with the result generated from commodity hardware rather than expensive specialist equipment.

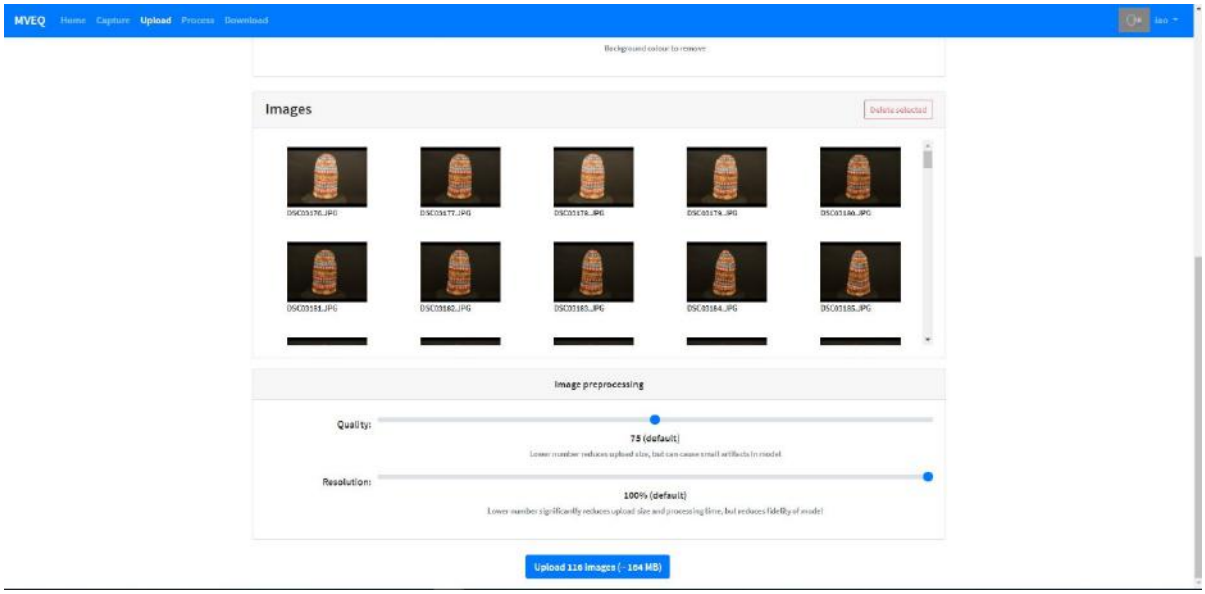


Figure 15 Setting IMage Sizes

Equipment to take the photographs required for photogrammetry, is either already available or available to buy at a small cost. Expensive cameras may help by a mobile phone camera or old digital camera will do a good job. However, computers with the capability to processing photographs to create accurate models are often not available and are expensive to buy. Whilst commercial photogrammetry services are available, they often compromise IP and can be costly or offer limited configurability.

Providing a free photogrammetry service, which can access multiple computing resources, breaks this bottleneck and opens the possibility of community digitisation of heritage objects and specimens.

Auto Photogrammetry Service

Digital 3D models of heritage offer possibilities for both the preservation and the promotion of heritage. A 3D model can be explored and manipulated without the danger of degrading the original artefact, multiple copies can be made which can in turn be viewed anywhere in the world. In the past, expensive and specialist equipment was required to make 3D models, but using the photogrammetry process, commonly available commodity computers, phones and cameras can be used. The bottleneck

in the system is access to computers with the memory and graphical capability to process high quality models. To address this bottleneck, CINE developed a structure from (motion system) as a service.

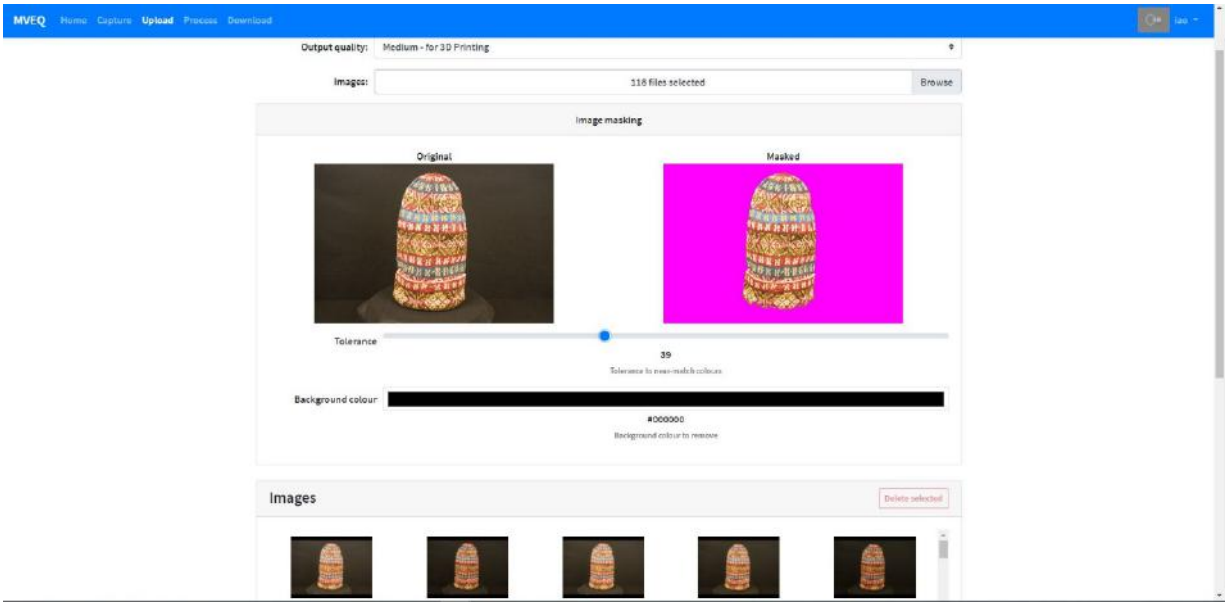


Figure 16 Setting mask sizes

Prior to using the system, users take the required photographs of an object using the photogrammetry (Structure from Motion) method. Users then create an account login on CINEGate, upload a zipped folder of photographs, configure the settings and download the digital model files in return. The idea is to use the CINE Auto Photogrammetry Service (CAP) as part of a structure from motion or photogrammetry workflow.

It has a web-based interface which uses the uploaded images and runs them through MVE (Multi View Environment) and TexRecon to generate a textured mesh and is put into a .zip file. All values chosen in the script were values recommended by MVE. We would check the fidelity of generated models to the actual object, then upload the successful 3D model to the original archive entry, changing it from “unprocessed” to “3D model”. If the “Cleared for Release” and “Social Archive” boxes are ticked, the model would automatically upload to the indicated collection on Sketchfab.

CINEGATE contains a related toolkit which supports the Digitisation of Artefacts. The toolkit contains:

5. Guides to the structure for motion workflow, which describe each of the steps required.
6. Links to instructional videos showing step by step how to select artefacts, choose equipment, set up for the shoot and take the photographs.
7. Link to the CAPS system which will automatically process the photographs and return a 3D model.
8. There are also example images that can be used to practice photogrammetry on.
9. Links to a gallery of 3D artefacts showing how the final output can be used.
10. A Trello board with more resources.
11. A Wiki link for discussion.

The CAPS system is accessible from the CINEGATE website in the Digitising Artefacts Toolkit. This system allows you to upload your photogrammetry images to be processed and then download the results which could then be uploaded to CINEGATE for used for some other purpose.

To use this system first go to https://photogrammetry.openvirtualworlds.org/ and then register for a new user unless you have already created one.

There is a guide to taking the photographs to make a model here:

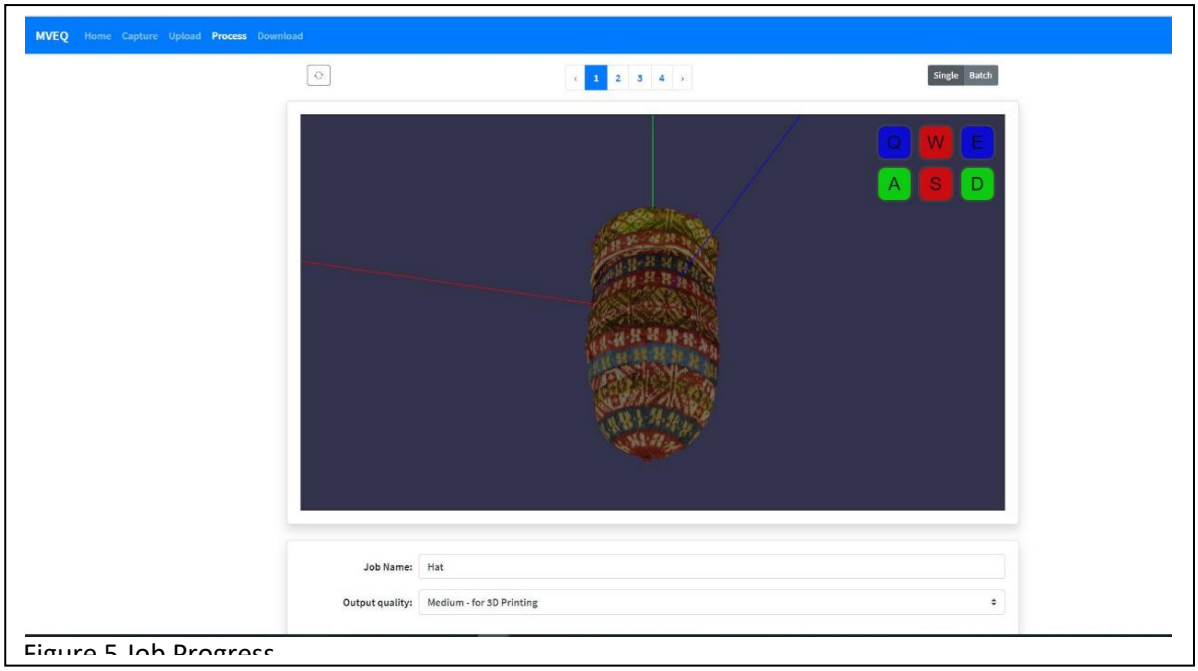


Figure 5 Job Progress

https://photogrammetry.openvirtualworlds.org/web/capture.

Once you have your images click on the upload link on the top bar of the website. This will then allow you to name the job select the quality and upload the images.

Once you have selected the images you will get the opportunity to specify what the background colour is and select the tolerance. This will be used to create a mask for the images to remove the background for processing. You want to select a background colour which does not appear in the model. You also go through your images and remove any from the list that are bad or superfluous before submitting for processing. You can also then select the quality and resolution for the processed image. Once you are satisfied press upload image to add them to the queue.

If you click on the Process link at the top you will be able to see the status of your jobs. You can click on a job to see details of its progress. Once it is finished you can press on the Show 3D preview button to see what the results of the process are. If you are happy with this process then you can press accept to make the results downloadable, if you are not happy with the results you can press delete to remove the results.

Behind the scenes this service can make use of multiple computers to process the images and has large amounts of memory available giving it the capacity to process large data sets. Of course, smaller data sets will process more quickly. We support people who are digitising digital heritage in this way, so please do get in touch and let us know how you are getting on and if you require and help.

Evidence

Example Gallery of 3D digital artefacts from St Catherines Church Donegal and hosted in the CINEG project virtual museum.
https://cineg.org/galleries/orgcontents.php?id=491&collectiontype=Physical%20Object

The CINE Auto Photogrammetry Service (CAPS) is available from the following link:
https://photogrammetry.openvirtualworlds.org/web/home

St Barbara Statue from Skriduklauster Monastery created using auto photogrammetry service:
https://cineg.org/type-gallery-page/?itemid=198&type=Physical%20Object

CINE IIIF Gallery Service (CIGS) , period 6

The International Image Interoperability Framework Gallery Service supports the creation, curation and sharing of digital galleries providing a core service for delivering museum experiences to the home. These can be circulated widely and made accessible globally. Knowledge about heritage protects landscapes and environments. The Connected Culture and Natural Heritage in a Northern Environment (CINE), ran from 2017-2020. CINE transformed people's experiences of heritage sites and material culture, through technology, building on the idea of "museums without walls". The International Image Interoperability Framework (IIIF) is an open-source framework providing support for creating galleries. This document describes the CINE IIIF Galleries Service (CIGS), a specific solution which forms part of the "Virtual Museum Infrastructure and Toolkit" and contributes to the program sustainable management of natural and cultural heritage output indicators. The CIGS supports the creation, curation and sharing of digital galleries providing a core service for delivering museum experiences to the home.

Keywords— virtual reality, digital gallery, museum at home (key words)

International Image Interoperability Framework Gallery Service

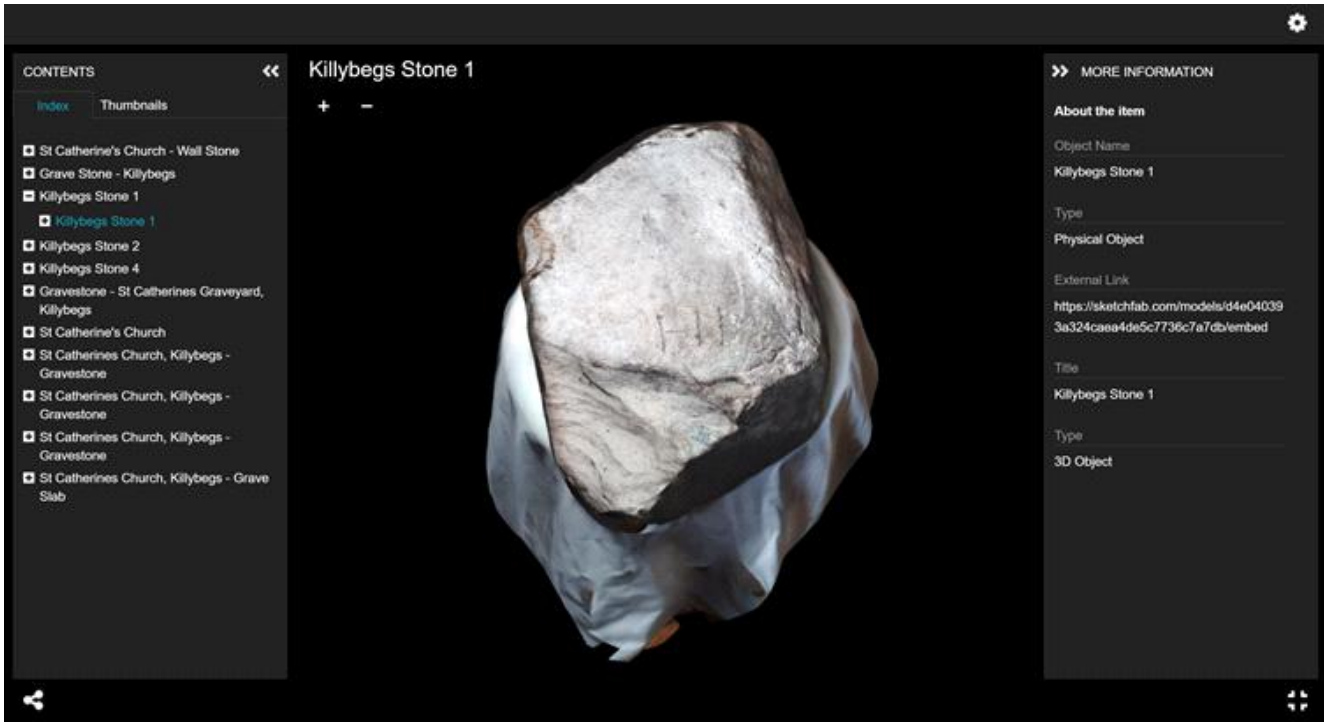


Figure 1 Gallery of artefacts from Killybegs Donegal [1]

The impact of COVID 19 has brought home the importance of engagement with heritage for education, health, entertainment and the economy. Being able to access a museum experience from the home or engage and engage with curated digital content has become a core part of how end users engage with heritage and how heritage organisations provide content. Through developing a

Virtual Museums without Walls and a virtual museum infrastructure CINE enables museums to do just that. The idea of a Virtual Museum Infrastructure is the development of a set of resources which enables heritage professionals and volunteers to create resources which provide4 or contribute to a virtual museum experiences. Central to museums is the ability to engage with artefacts and objects which enable us to what life was like in the past. Similarly central to Virtual Museums is the ability to curate digital galleries, containing digital representations of heritage. The idea of CINE IIIF Gallery Service (CIGS), is to provide a service within a VMI that enables heritage organisations to create digital galleries, that can be accessed and explored on user devices via the Internet. We have built on and enhanced the exiting Image Interoperability Framework (IIIF) to integrate it with the VMI and to extend the functionality of its Universal Viewer to include spherical media. Consequently, CIGS provides support for images, video and 3D models which are held in the digital archive or linked to from a third party.

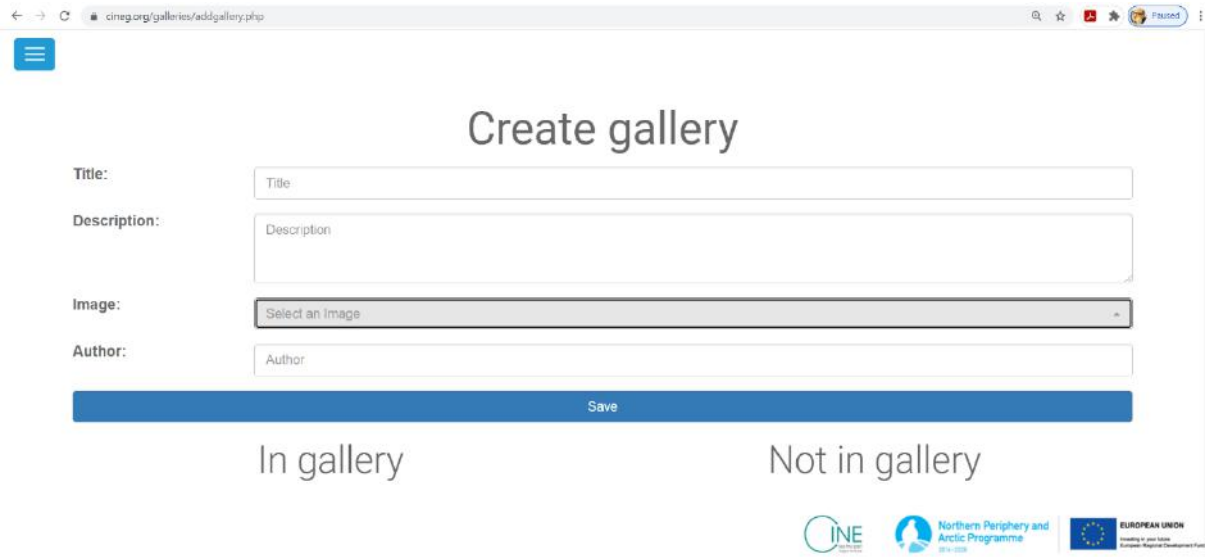


Figure 3 Create a gallery dialogue box

CINE IIIF gallery service

The CINE project provides a gallery service which enables heritage organisation to create digital galleries and make them available online. The gallery system is based upon the International Image interoperability Framework (IIIF) but provides functionality which enables organisation to create and USE IIIF galleries without the overhead of managing the supporting infrastructure of databases and servers.

The Service that CINE provides is called CINE IIIF Gallery Service of CIGS. It is built on and integrates with CINEG making use of CINEG's metadata, archiving and data entry capabilities. The IIIF framework is extended by CIGS so that it supports spherical media, both video and audio. There is also support for 3D models, rectangular images and video and audio.

The galleries enable navigation through a side pain with support for multiple media being associated with each subject. The galleries can be embedded into web pages and shared directly to social media enabling them to be connected into narratives and to exist as standalone galleries.

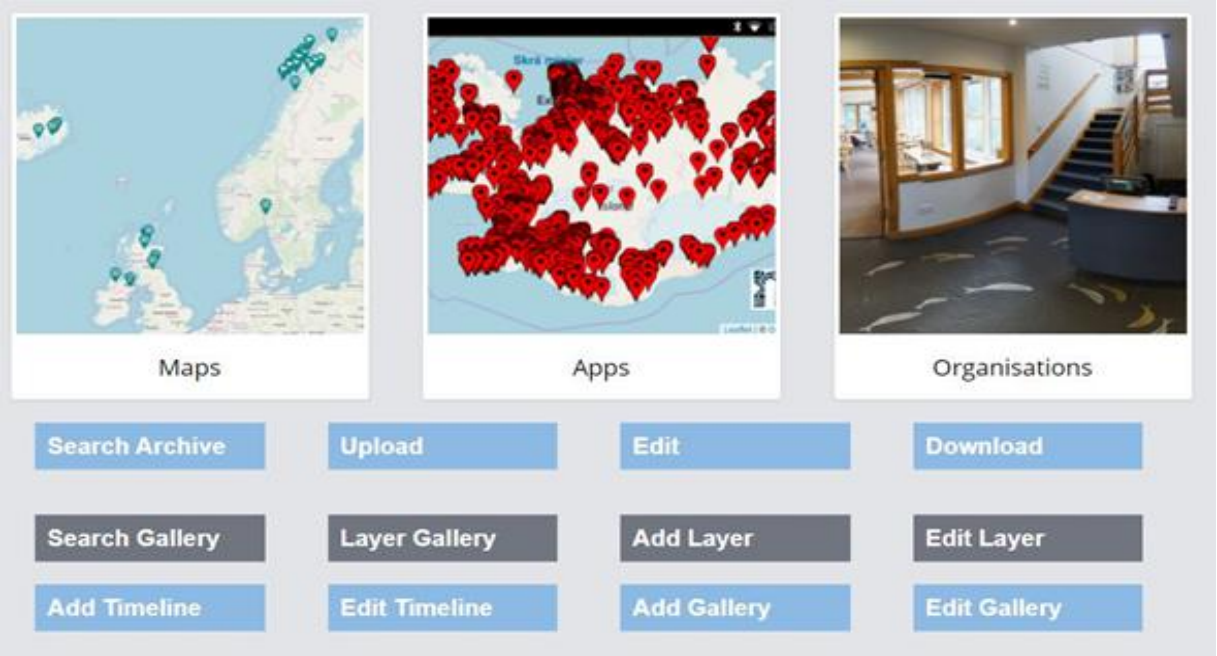
The CIGS system is used within CINEG to provide galleries of the CINE Talks, the Heritage at Home events, of media associated with reconstructions, 3D galleries, 360 Tours and more.

How to make a gallery

To create a CIGS gallery in CINEG system three things, need to be done. First you should be logged in to the virtual museum. Galleries in CINEGATE are made up of layers so you need a layer to create a gallery from. Contents of the gallery – media and meta data are imported from one or more layers. They will automatically update as the content of the layer is updated.

To create a gallery go to the front page of cineg.org and press on the Add Gallery button, this will take you to the gallery creation form. This form will allow you to give the gallery a:

1) title, a word or two summing up the subject of the gallery
2) description, upto about 1000 characters describing the subject, context and contents of the gallery
3) an image that will be used in summarising the gallery
4) name(s) of the people who curated the gallery, authors of items within the gallery will be credited separately.



A title field is required, and all other fields are optional. Though a gallery should also have descriptions, so people know what your gallery is about, an image to visually identify it and credit should be given to the authors. Once you have completed the form press the save button to create your new gallery.

Editing and managing a gallery

CINE see the past imagine the future
Northern Periphery and Arctic Programme 2014-2020
EUROPEAN UNION
Investing in your future
European Regional Development Fund

Once a gallery has been set up to be useful it is necessary to add content to the gallery. The way this is set up allows the gallery to pull in contents from the CINEG archive and to be automatically updated as contents are added to the archive.

Clicking on the EDIT Gallery button will bring up the edit dialogue box. This allows the addition and removal of both collections and layers from your gallery. Usually, a gallery will be made up of one layer of collection. In this case you can manage the contents of the gallery, by adding ro removing items from the appropriate layer of collection.

The edit form for your gallery will then be loaded and you can add layers or collections to your new gallery. This page will also list the URL that you can see your gallery on and its ID number which you can use in Wordpress to create a page for the gallery.

Different ways to share a gallery

Once a gallery has been created it can be added to the CINEG galleries, a Wordpress page can be created from a template, it can be shared to social media, through twitter and the like or embedded in web pages.

Once your gallery has been created you can easily create a WordPress page for it. There is a template called Gallery Page in the main CINEGATE WordPress. You should duplicate this page and then edit the newly create duplicated to give it a sensible name and put the galleries ID number into the Omeka id box at the bottom of the page. You can then publish the page which will now contain your new gallery. The elements on this page can be move around and additional content can be added to the page in the normal fashion.

Evidence

Example IIIF Gallery of 3D digital artefacts from St Catherines Church Donegal, hosted in the CINEG project virtual museum.
https://cineg.org/galleries/orgcontents.php?id=491&collectiontype=Physical%20Object

Example IIIF Gallery with Roundme embed

https://cineg.org/type-gallery-page/?itemid=108&type=Allself

Example IIIF gallery with video content

https://cineg.org/media-gallery-page/?itemid=12

West Highland Museum 100 online galleries and interactive maps developed from Virtual Museum Infrastructure. This includes archive system linkded to IIIF galleries an dinteractive maps with linked galleries.

https://whm100.org/

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