Immersive Installation: “A Virtual St Kilda”

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Abstract This paper discusses a Virtual Histories project, which developed a digital reconstruction of St Kilda. St Kilda is the most remote and western part of the United Kingdom. It was evacuated in the 1930s and lay empty for several decades. It is a world heritage site for both built and natural environment . The Virtual St Kilda acted as a focus for the collection and presentation of tangible and intangible cultural heritage. It was on show as an exhibition in the Taigh Chearsabah museum (Figure 5 located in North Uist Scotland. The exhibition is built around the OpenSimulator Open Virtual World server using commodity hardware. The simulation covers some 4 square km of virtual space, and models both tangible and intangible culture. It is integrated into an exhibition and articulates an interpretation of the St Kilda legacy through the prism of contemporary North Uist life.

1 Introduction

This paper discusses the use of Open Virtual World Technology to create an immersive museum exhibit of the St Kilda world heritage site. The exhibit has been enjoyed by thousands of people at the Taigh Chearsabhagh Museum and Arts Centre. It includes a 3D inter active model of St Kilda as it was in the late 19th century. The model is based upon archaeological evidence [Emery, 1996, Stell & Harman, 1988, Harman, 1996] and provides an accurate portrayal of both the geography and architecture of the Village bay area of Hirta the largest island of the St Kilda archipelago.

St Kilda is a cultural and natural world heritage site. It is of immense interest both for its history and natural environment. Yet it is remote, requiring a four hour boat journey from the Outer Hebrides, consequently an exhibit which captures the spirit of the islands is an attractive proposition. The goal of this project was to make such an exhibit using open source software and commodity hardware. For this to work the exhibit had to be easy to use, reliable and capture the scale of the environment. The exhibit was to be unmanned. Therefore visitors had to be able to walk up and use it without training. Secondly, the exhibit had to run reliably for months without intervention, save being turned on and off at night. A key aspect of St Kilda is the size of the cliffs and surrounding hills and the relationship between human habitation, agricultural architecture and natural environment. To capture this a model which represented several square kilometers of real space would be required. Further the exhibit was to integrate the many songs and stories which make up St Kilda’s rich culture.

Fig. 1 Panoramic view of Virtual St Kilda main street

2 The St Kilda Archipelago

St Kilda is an archipelago about 40 miles west of the outer Hebrides, in Scotland. It is both the most western and the remotest land in the British Isles. Evidence has shown that St Kilda's history goes back at least as far as the bronze age. St Kilda's remoteness makes it entirely unique. The culture that developed there over the millennium during which it was inhabited is like no other culture in Britain. Similarly the natural life on the island is also a breed apart, literally in some cases. There are species of birds and mammals on St Kilda found nowhere else. St Kilda is also a place of great rugged, beauty. It is sheer rock rising out of the Atlantic, the last bit of land before you hit America. All these factors make it a place of fascination for many. It has been designated a UNESCO world heritage site for both its natural and cultural value. It is one of only twenty four such dual sites in the world and the only one in Scotland. As St Kilda is such a remote site, very few visitors will ever get to go there.

The archipelago consists of five islands (Soy, Boneray, Dun, Levenish and Hirte) and several sea stacks, including the highest stack on the British isles. Hirte, the only inhabitated island was evacuated in 1930. Villagers lived on the only street on the island (Figure 1), located on Village Bay. This street, known simply as 'The Street' is lined with crofts, Blackhouses (traditionally Hebridean dwellings with thick walls and doors facing away from the sea) and Cleits (dry stone storage structures, unique to St Kilda, which cover the St Kildan landscape, more than 1100 in total, Figure 8). Village Bay is the closest thing Hirte has to a safe landing. Even in modern times poor weather makes it impossible for boats to offload cargo. When the island was still inhabited the islanders would sometimes go months, or whole winters, without receiving supplies from the mainland. All the factors that make St Kilda special also make it an excellent subject for a reconstruction. Its striking geography is something that can be hard to translate in still images or videos but translates well into being explored virtually. Visitors are unlikely to be able to experience it themselves. The stories that are linked to it interesting strike a universal chord.

The St Kilda model was developed in the first half of 2014. It is a technically challenging model, spanning 4 square km. This is orders of magnitude larger than is normal in OVW models. In order to support the larger size the client was modified to

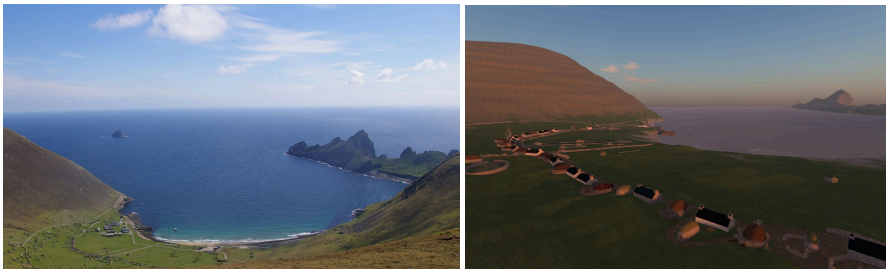

Fig. 2 Virtual and real views of St Kilda, across village bay, looking out towards Dun.

extend the far clipping plane of the view frustum. This enabled views that span from village bay out to the easily recognisable outline of Dun, to the south (Figure 2). Extending the visible area to include this greatly increases the sense of presence and ensures that the iconic vistas of St Kilda can be recognised immediately. The terrain data is taken from Ordinance Survey GIS information. The reconstruction covers village bay with objective to represent enough of the space such that, when standing in the centre of the village visitors get an accurate impression of the geography in all directions. Modelling focussed on the village itself, here the crofts, Blackhouses and Cleits are all modelled. The models for the Blackhouses and Cleits were developed in external modelling software and were both used as imported meshes and to create high fidelity images and videos using special effect software.

The model is dated to the 1880s. The reconstruction has been augmented with a number of NPCs. Records from St Kilda are relatively complete so each NPC is named after a real inhabitant of village bay and their appearance taken from contemporary photographs. The model also features embedded content displayed as web pages. Throughout the model there are items which contain further information. These glow when the avatar approaches. When clicked on the viewer’s inbuilt web browser displays a web page with text and images presenting information linked to the glowing object.

3 Development Process

The development of Virtual St Kilda was a collaborative process featuring an artist at the University of St Andrews (Sarah Kennedy), expert advice from the National Trust for Scotland (who manage St Kilda) and Access Archeology, a community archaeological group on North Uist. Once the model was developed supporting material was produced with a range of collaborators, both local and national.

The first stage was to use GIS data to create the landscape in which reconstructions would sit. In St Kilda this is particularly important as the shape of the land is one of the most recognisable aspects of the site. The GIS data used is the Ordinance Survey high resolution data.

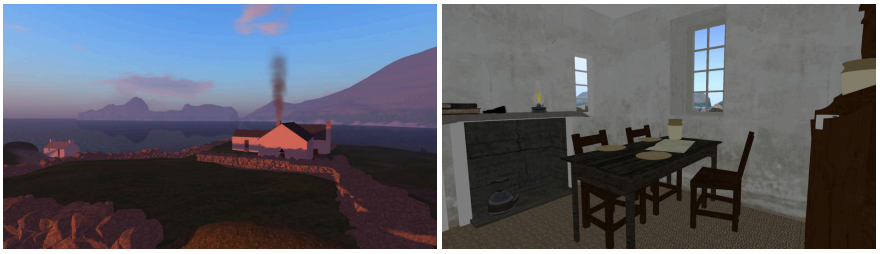

Fig. 3 External view of Manse and Internal view of Blackhouse model.

With the GIS landscape loaded measurements from the site were used to map out the location of every structure to be modelled. These measurements include Google Satelite view data, contemporary accounts and photographs and archaeological surveys. The site as it stands today is relatively unchanged. Several of the crofts have lost their roofs and there is now a modern base but otherwise the structures stand where they have stood since 1880. Having plotted the location of each structure surviving evidence of the site is surveyed as material to be integrated into the model. As part of this process areas of particular interest, recognisability or iconic status were identified. The date for the reconstruction is within the photographic era. Despite this there are still areas where no direct evidence is available showing precisely how it was in the past. In these instances more general evidence such as equivalent sites and written reports can be used to create a best guess at how that part of the model should look. As the model was developed there were meetings with experts from the National Trust for Scotland and with members of the Access Archeaology group in Uist to gather feedback. These meetings allowed expert interpretation to be incorporated into the development process. It is often the case that the ability to view an artifact, building or other element in its natural situation will allow theories to be tested and plausibility evaluated. As changes are relatively simple to make multiple different versions of the same feature can be created and experts use these to make a decision about what is most likely to be correct. In this way the iterative design cycle of the Virtual Time Travel Platform platform enables research into the heritage aspects of the projects. Views of NPCs inside a typical 1880s house and crops growing are shown in Figure 4.The outside of the manse church complex and the inside of the manse parlour are shown in Figure 3. The system architecture used to support this development is dicussed in some detail in [McCaffery et al., 2013] and an expansion of the reconstruction methodology can be found in [Kennedy et al., 2013].

Once the model is created it is populated with content to help those who interact with it learn about the topic. This means adding multi media content and Non Player Characters. The model in turn is raw material that can be integrated into traditional media such as videos and still images, which can be distributed online or included in papers, newspaper articles and informational posters.

A set of videos was created as part of a program of community involvement. North Uist's links to St Kilda mean there is a wealth of material about the archipelago in the community. Many of the islanders have travelled to St Kilda and the video

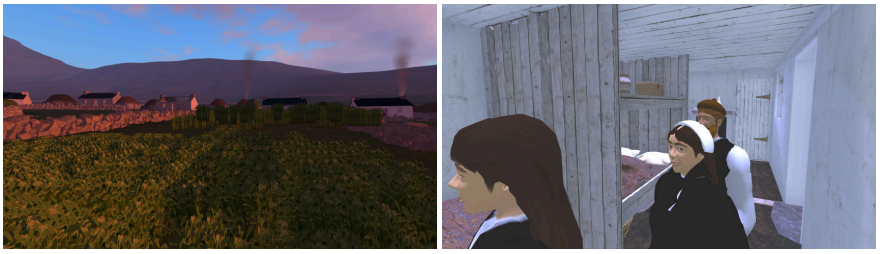

Fig. 4 View of Cale growing in village bay and residents in past 1830 cottage.

and images they brought back were made available for the project. Images shot on St Kilda were used to make posters for the exhibit and as part of the embedded web pages. Two separate Uist organisations, Uist Film and Island Voices, had produced films about St Kilda. The footage in these films formed the majority of the live action footage which was integrated with virtual footage to produce short videos about St Kilda. The rest of the footage was filmed as part of the project. In order to do this the Kilda Cruises organised a voyage to Hirte. Once there Qinetiq, the contractors who run the base, made transport available so that footage could be shot all over the island in a short space of time. Local groups of musicians, including the Gaelic singing teacher for the area, a ceilidh band group known as the Spring Chickens and children at local primaries, recorded pieces related to St Kilda. These were used in these videos. In the same primary schools pupils researched St Kilda and wrote narratives telling the stories they related to about their far flung neighbour. The childrens’ tellings of these stories were recorded and combined with virtual footage and the other material gathered to tell some personal tales with a distinct North Uist voice. Community produced content was combined with National Trust for Scotland archive footage to illustrate some of the more historical aspects of the site. Technology students at a local college produced posters which advertise the exhibit. The National Trust also provided access to a recording of an interview with one of the last inhabitants of village bay. This interview was combined with virtual footage and footage supplied by local groups to create videos telling another form of story about life on St Kilda.

Products of the community engagement include videos available online, streamed into the model and part of the St Kilda exhibit. These videos, as well as the posters that were produced and also the many events that were used to gather the material and share it with the community, help extend the reach of the project in directions that complement the model itself and ensure value in multiple contexts.

Records exist of who lived in what house during the time period. Linked with these names are historical documents photographs. Using this data NPCs where created to represent real inhabitants. These NPCs are scripted to walked through the town, performing the activities that would have filled the islanders days. These NPCs can interact with the user, they can speak, both in audio clips and through text. The research for the NPCs was helped by local knowledge, and by the National Trust for Scotland.

Fig. 5 Taigh Chearsabhagh Museum and Arts Centre and Virtual St Kilda Exhibition.

4 The Exhibition space and Exhibit

The room in which the exhibit is installed is a large, barn like, room within the museum. The room is a cuboid space approximately 5m across, 15m deep and 6m high. There is no ceiling, just the beams which support the roof. The door is situated on the front wall, opposite the mezzanine balcony. The installation consists of a 3x1m poster along one wall, a projection covering the width of the front wall, coming down low enough to cover some of the door, a table with a 25" monitor and an XBox controller. The table is overlooked by a Kinect. Everything is controlled by a computer on the mezzanine level. This connects to a projector creating the projection and a wireless received for the XBox controller. The monitor receives its signal through a wireless HDMI kit. A powered USB cable runs from the mezzanine down to the Kinect.

The exhibit itself is made up of a series of short videos, ranging from two to ten minutes long, and a free exploration mode where the visitor uses the XBox controller to explore the model. The videos are intended as short, standalone pieces. They are designed with reference to the youtube format where information is presented in small sections but linked with more information so interested users can explore further if they wish. Videos cover subjects such as health on the islands, what Blackhouses and Cleits are and recordings of music with known links to St Kilda. There are also two longer videos. The first, 'The Story of St Kilda' is a seven minute piece composed of a mix of real world footage and virtual footage introducing St Kilda and the different aspects that make it special and some information about the exhibit. The video has a voiceover narration each paragraph of information is narrated first in Gaelic and then English. The second long video is a ten minute long mood piece of the sights and sounds of St Kilda. This is designed to run when visitors have not started interacting with the system at all.

The Blackhouse[1] and Cleit[2] videos combine renders, done using special effects software, with real world footage, shots from the main model and recordings of local residents performing St Kildan songs. The special effects shots integrate animated text and effects, such as smoke, into a high polygon mesh of the structure (Figure 8).

[1] https://vimeo.com/94504484

[2] https://vimeo.com/99984295

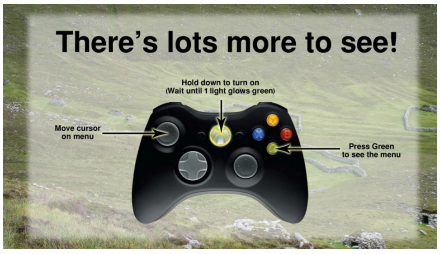

Fig. 6 Prompt encouraging visitors to pick up the XBox controller.

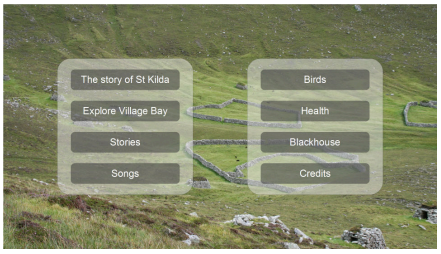

Fig. 7 Main menu for the St Kilda exhibit.

The high poly meshes were then simplified and imported into the model. The modelling of the Cleits and Blackhouses was done by Alice Watterson and the animation by Alice Watterson and Keiran Baxter. The videos which tell general stories of St Kilda combine virtual footage and real footage. In these videos a static backdrop shot was filmed in the virtual world. Pupils from the local Cairnish primary school were recorded, twice, telling stories they had researched and written out about St Kilda. The first recording was audio only to get a clear recording. In the second a projector was used to cast shadows of the pupils over a white backdrop. This shadow footage was later manipulated in Blender to produce a pure black and white mask of their shadow. The final composite features the children’s audio and their shadow projected over the virtual background. A frame from one of these stories is shown in Figure 9.

Virtual shots of the larger used in the Blackhouse and Cleit videos, as well as in the ‘Guided Tour’ are more dynamic than the static backgrounds of the stories. Camera movement’s are programmed and then played back using Chimera. As they are played back the video stream from the computer is routed through an external device that can capture the stream to an SSD drive and simultaneously patch it forward to an output device. When camera movement is introduced any problems with framerate become readily apparent. The video is recorded at 30FPS so if the client is rendering fewer frames than this output smoothness is jeopardised. Another problem encountered in moving shots is tearing as the camera pans. To solve these problems Chimera’s ability to record at a reduced speed is used. By recording the camera moves at 10% or 1% of the intended speed many frames of recorded material cover a single frame of intended output material. When the footage is sped up again samples across these multiple frames produce a much smoother final image than recording at full speed. This process produces smooth shots without the necessity of reducing graphical options to achieve an optimal framerate. To work all dynamic movement in the scene had to be slowed. This meant adapting scripts which make waves crash, birds circle and smoke sputter to operate at a reduced frequency and not appear hyperactive on the sped up footage.

The exhibit is designed to run without the presence of a member of staff. When the first visitor of the day enters the room the exhibit is playing the mood piece on a loop. This remains until the visitor either moves to the back of the room or starts to

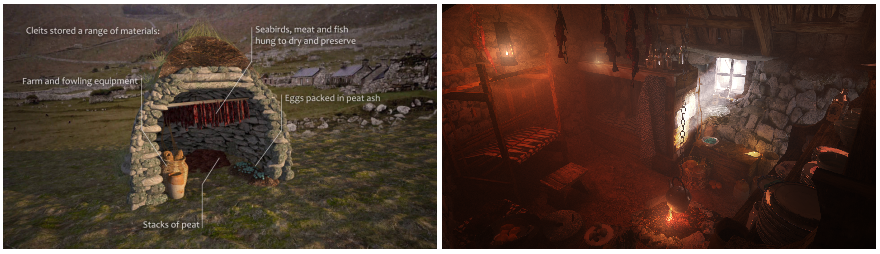

Fig. 8 A frame from the Cleit animation and render of the inside of a blackhouse

press buttons on the XBox controller. When presence is detected in the room by a Microsof Kinect the Guided Tour is played. Once this has completed a notification appears telling the visitor that if they wish to explore further then can pick up the XBox controller and go to the menu (Figure 6. If they do not do this the Blackhouse video plays, followed by one of the recorded songs set to real world footage of St Kilda. Once this has completed the visitor is again prompted to engage with the XBox controller. If they do not more content is presented automatically. After a third prompt the exhibit will go back to playing the mood piece. If at any point the user does engage with the XBox controller they can press a button to go to the main menu. From the main menu, shown in Figure 7, they access all of the content in the model. To do so they use the joysticks on the XBox controller to move a cursor. When the cursor is hovered over a menu item for a couple of seconds that menu item is selected. Most menu items are made up of several videos, played back to back. Special cases are the option to explore the world directly and the credits. As well as prompts on the screen the exhibit also features laminated signs, instructing the visitor how to control it with the XBox controller. While the exhibit is generally designed not to require staff intervention members of staff will occasionally go into the exhibit and give tours of the content. In these tours they can highlight areas of interest to specific visitors and tailor the experience to the group. This format also means that visitors who might be put off by having to engage with technology can have a more directed experience than simply watching the automated content play.

A core design principle is community involvement. North Uist is a remote island with a relatively small population. Many people on the island have direct connections to St Kilda. Some have links to the people who once lived there, others work, or have worked there. In order for the exhibit to be received well and integrate into the environment where it was intended to be installed it was very important the local population took ownership of the project. The videos feature footage shot by local groups, recordings of local musicians and videos of local primary school students telling stories of St Kilda. Taken together this means that the exhibit is a combination of documentary and interpretation. Local, historical, academic and virtual all combine together to create something which is multi faceted and tells the story of a unique place in a unique way all through a strong local voice. The end result is something that the community is happy to publicise to the world as their perspective on a site of international interest.

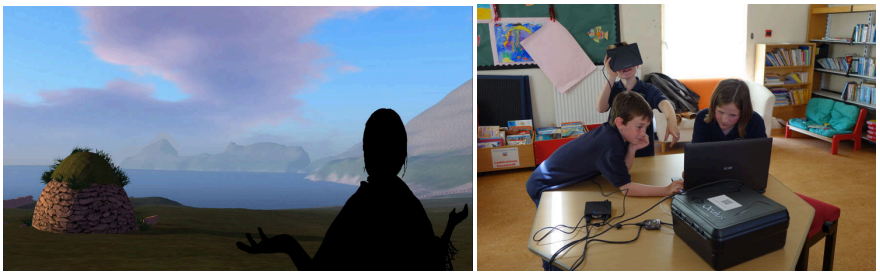

Fig. 9 A frame from the Lady Grange story. School students explore in stereoscopic 3D.

5 St Kilda in Schools

As well as installing the St Kilda scene as museum exhibit it was used as the basis for workshops across North and South Uist and Benbecula, known collectively as the ‘Long Island’ (Figure 10. These islands are three of Scotland’s outer Hebrides. Workshops were done in three primary schools and in an adult learning centre. Two of the schools (Lochmaddy and Cairnish, both on North Uist) were primary schools with only a few dozen students across the 7 primary classes. The third was a larger primary school on Benbecula where students were streamed into Gaelic and English classes. In all schools a computer was set up with a projector and an XBox controller that pupils could gather round and watch content on.

In Lochmaddy one group, consisting of the older classes at the school, attended the exhibit. In Cairnish the pupils were split into two groups, younger and older. In both schools the pupils had been involved in the creation of the content and where excited to see themselves projected on the screen. Sessions in Lochmaddy and Cairnish started by showing the ‘Guided Tour’ video, to introduce the material, and then showing the footage that the children had been involved in the creation of. Having seen the linear material the projector was switched to showing the virtual world and the children were given the opportunity to use the XBox controller to explore St Kilda. When exploring the children were prompted to take turns with the XBox controller, with all children not currently in control able to watch the projection and talk amongst themselves and to the child in control. This process was allowed to be relatively free, pupils were not forced to stay quiet and watch passively, they were encouraged to talk amongst themselves and to commentate on their experience. This lead to very enthusiastic sessions with much laughter and interaction. Pupils enjoyed being able to fly, especially when the ability to cease flying and watch the avatar fall from a height down to the ground was discovered. One of the consistent things that pupils enjoyed was attempting to find unexpected parts of the scene. Exploring underwater or trying to find houses which they were not supposed to enter and to get inside them.

In Benbecula primary 6 students visited the workshop, split between the Gaelic and the English streams. Where the settings in Lochmaddy and Cairnish were relatively informal in Benbecula larger class sizes and older students required more structure. In Benbecula each class sat down and watched the ‘Guided Tour’ video. Having watched the video they were split into two groups, with each group given

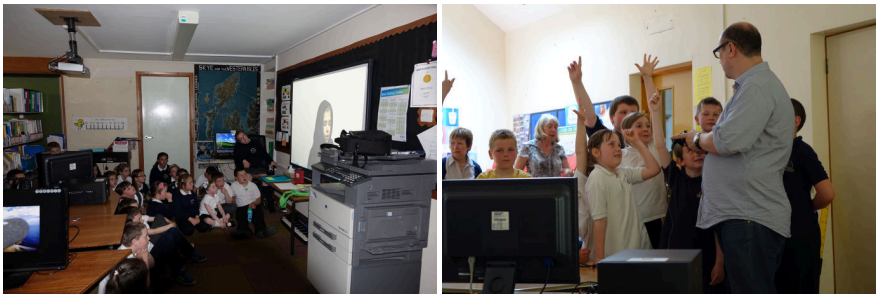

Fig. 10 Pupils in Lochmaddy and Cairnish engage with the content.

access to a computer running the scene. In the groups pupils were encouraged to explore and think about questions such as 'How many people do you think lived in the village?' and 'What do you think it might have been living in such a remote place?'. Pupils were encouraged to share control such that everyone had a turn in charge of the avatar. After approximately twenty minutes the groups were relaxed and pupils had the opportunity to try out the Oculus rift. When pupils were initially given control there was some hesitance as to what they should be doing. All groups did explore the scene thoroughly. When the groups were relaxed and some pupils went to try the rift the noted tendency was for those to remain to focus more closely on the scene. Smaller groups lead to those with particular interests getting longer to investigate and familiarise themselves with the content.

6 Conclusion

This paper has described the creation of the Virtual St Kilda Exhibition. The exhibition provides insight into the lives of people who lived there in the 1880s. It enables appreciation of the relationship between the natural environment and human habitation, In doing so it enables visitors to make use of existing digital literacies to explore the past. Trough using commodity hardware and opensource software it has been possible to create an exhibit which captures both intangible culture the stories, songs and lives of the inhabitants and material culture the buildings and artefacts.

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