Summary: "Technologies and tactile models"

From experience, diverse engagement projects show that tactile and haptic exhibits are vital for visually impaired visitors when visiting Museums and Galleries; often however, there are either not enough exhibits interpreted in this way to encourage return visits, or, in some cases, there are no provision at all. As funding is often limited within European Cultural Institutions we need to understand the cost-effectiveness and future potential for these technologies and newer digital technologies both within a gallery space and as an outreach activity.

Many institutions have good audio tours and tailored sessions for VI groups. Tactile elements are created in the form of replicas and raised line or thermoform images, as supplements for exhibitions, engagement sessions and for permanent collections.

The inspiration for developing tactile, haptic and digital touch technology at Manchester Museum came from attending the "In Touch with Art" conference at the Victoria and Albert Museum in London in 2010. The conference addressed "Equal Access to Museums – implementing the cultural rights of blind and partially sighted people" and the process by which this could be achieved within cultural organisations. The conference produced a ground-breaking Conference Resolution on 'Equal Access to Museums for Visually Impaired People'. Similarly, the VRVis Research Center started its research on make paintings accessible to visually impaired people in 2011, out of the lack of digital tools that help in the image to relief conversion process.

It became obvious that museums and galleries should be far more ambitious in their aspirations to provide access and resources and look at innovative ways of addressing this. There are good conservation reasons for not touching many types of artefacts paintings and drawings – however digital technology now allows us to create very accurate 3-dimensional, colour and structural data files, without risk to the original, from any scale of object, or raising paintings into relief, which can then be replicated and shared.

Digital technologies are providing a shift in the way we engage with material culture on the galleries, outside of the visit and online. There is a universal drive for Museums and Galleries to digitize collections and it is important that people with various types of disability have access to this resource and have the skills to use it adequately.

Our goal for the AMBAVIs project was to understand how to create tangible outputs using new 3D digital technology that would be of value to VI visitors now and in the future.

Over the course of the project, we exchanged ideas, utilized existing prototypes and developed new methods to present objects physically and virtually. To this end, four different digital haptic tools have been developed. Two of them are concerned with the presentation of multiple objects within the same device, one of these using virtual reality 3D touch-enabled display technology with the ability to display multiple objects and collections and the other, a mechanical physical relief production device, which could be made to create temporary models on demand.

The other two technologies explore digital interaction methods directly on physical reproductions, one uses finger tracking technology and the other uses embedded sensors in a 3D replica, in order to enrich a tactile haptic experience.

The four different technologies have been tested by the VI focus group in two different evaluation workshops one in Manchester and the other in Vienna. The goal of the evaluation was to assess how beneficial these technologies are for the target group at present, how they can be improved and what their future potential may be.

In order to test the ideas and outputs, the project consortium agreed upon two artefacts which are translated and augmented by the four different technologies. One two-dimensional and one three-dimensional object were chosen as they are perceived quite differently, inherently in their translation process and how different they are from the source object.

The three-dimensional object which was chosen by the working group was the 2500 year old Manchester Egyptian Cat Sarcophagus, as it is a very fragile important object within a major touring UK exhibition about Egyptian Animal Mummies. The exhibition is travelling to Glasgow and Liverpool after being exhibited at Manchester Museum. The Sarcophagus is particularly interesting because it has good historical provenance, has been the subject of scientific research at Manchester University and has an internal cat mummy which will never be removed from its wooden encasement.

The Belvedere focus groups chose Gustav Klimt's painting "Der Kuss" (The Kiss) 1907–1908. It was chosen, because it is one of Austria's most famous paintings, which generated much interest in the focus group and the only resources for the visually impaired visitor at that point were descriptions and a simple raised line diagram. The painting is very challenging because it is a mix of figurative elements, abstract patterns and raised geometric forms.

The four technologies:

The first two tools are concerned with a haptic / touch interaction without the need to actually produce a permanent, physical model.

- **Probos** allows the user to virtually touch and explore very accurate scans of museum and gallery objects in a virtual 3d space with a digital force feedback stylus. The device has the potential to display many objects.
- **The Relief Printer medium** is a concept for temporary 3D prints in relief, with a much smaller preparation time and which does not consume material nor produce waste. This novel concept is inspired by the pin-art toy and consists of tens of thousands movable pins that can approximate any relief surface.

The other two tools explore digital interaction methods in order to enrich a haptic / touch experience. Both are implemented to give Audio Feedback based on where a person touches the objects.

- **Digital Touch Replicas** are based on tactile sensors being invisibly embedded all across the surface of very accurate physical replicas of artefacts; these release sound, text, image and video files when touched. The information or data on these sensors can be changed and updated.
- **The Gesture-Based Interactive Audio Guide** uses a depth camera above the object to track the user's fingers, which accurately delivers audio files relevant to the area of a tactile relief being gestured above. In addition to touch events it can detect additional gestures for various free programmable purposes, and allows to freely change and update not only the content but also the interaction regions.

What was clear from all of the evaluation is that every user had slightly different needs and expectations, but all four of the technologies were well received.

The Digital Touch Replica and the Gesture-Based Interactive Audio-Guide being the most easily understood, as they only required a short introduction and relied on the user exploring a physical replica.

With the **Digital Touch Replica** of the Egyptian Cat Sarcophagus the user listened to information being delivered through headphones whilst they physically explored the object and touched particular areas to release information. They liked that the material and size of the ancient cat sarcophagus was as close to the original artefact as possible, that there was a lot of information to release from the object as they

explored it and that it was easy to use. What was learnt from the workshops was that there were some issues with the timing and triggering of the information for some users and this will be looked at and amended in the software.

The **Gesture-Based Interactive Audio Guide** was slightly more complex and caused some confusion in the first evaluation session. After modifications in the user-interface, and once the user had listened to the revised instructions the interaction worked well and delivered information from well-defined areas of the painting giving extensive information about the subject matter. The created tactile relief was well received, and could give a good overview as well as tiny details. Several points for improvement were discovered, and will be addressed in a follow up project. With these implemented, and the addition of a proper housing this technology promises a low-cost, flexible and intuitive solution to augment any object without physical intervention.

The **Relief Printer Concept** was evaluated in the form of three prototypes of a printable **medium** with up to 31500 movable pins, in order to examine its tactile quality, to identify requirements on size and resolution and to assess its value for our VI focus group. Indeed, most test persons found the presented quality already acceptable, and especially liked the perspective to get fully tactile relief prints of digital models in a comparatively short build time and in a medium that can be re-used without ever consuming material or producing waste as is the case with current technologies. The positive feedback already sparked a follow-up project. As most people disliked the rough feel, updated versions with a softer touch will be developed, as well as implementations of the actual printer mechanics.

The **Probos** haptic interface was comprehended more easily in Manchester where many of the user group had used the computer interface before and had advised on amendments and could see that work for this project had improved since the early stages of development 2 years earlier; whereas the participants in Vienna came to the interface without any prior knowledge and after using the other much simpler and more physical replicas. They became frustrated by the complexity of the interface and it became clear from the two sessions that some training and facilitation is required to enjoy the interface. Two participants in Vienna who had some residual sight did like the interface; one of these gentlemen regularly used computers and could understand the future potential of the Probos with more development. There is a need for a number of amendments to the interface such as magnetic pull towards objects etc. that is outside of the scope of this project which would greatly improve the user experience, especially for the

totally blind user. Many of the participants could see the potential for the technology with further adaptations, especially as it could be a repository for large groups of objects giving VI visitors much more choice, and also aligning themselves more to visually able users who will also be using and feeding the development of this solution.

Having the evaluation sessions in Manchester and Vienna with the VI participants was vital to understand and see how the technologies were physically used and it became clear how we could change and improve all of the technologies.

The **Digital Touch Replicas** and **The Gesture-Based Interactive Audio Guide** can be deployed on the gallery in their current form and immediately improve VI visitors appreciation of artefacts on the galleries.

The **Relief Printer medium** has potential, if developed, to be a useful tool for a gallery and similar institutions as it can be reprogrammed to display different paintings giving the VI users choice, which is not available at the moment as the resources tend to be fixed in a gallery space. Especially combined with a gesture-based audio guide, and in the form of an interactive kiosk, it can give VI users access to a wide variety of objects without requiring physical reliefs or replicas, alleviating production costs, storage demands and sparing exhibition space.

The **Probos** is at the moment a beneficial experience for those VI museum and gallery visitors who have some residual sight and have had a little time to get used to the new computer interface which we have on the gallery in Manchester; however if invested in and developed further, including further software enhancements it has real potential to revolutionise access to collections for VI visitors. It could do this by bringing together a variety of collections of objects and paintings that can be digitised, prepared and made available to a sighted audience and at the same time be made more accessible to a visually impaired audience, this surely has to be one of the main objectives of the resolution in 2010. As this is a new digitised 3D platform with a virtual reality interaction it could also be seen to be a cost effective way of digitising museum and gallery collections and making them more inclusive and more accessible internationally.

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