museums AMBIENT TECHNOLOGY FOR

an investigation into **applying** the **benefits** of many modern **technologies** to **enhance** the **museum** goers' **experience**

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Abstract: A report documenting the design phase of the Master of Arts project 'Ambient Technology for Museums', detailing the development and final specification of the 'Museums through the Looking Glass' system outlined by the research phase. The system seeks to increase the scope of the present museum experience by incorporating the advantages offered by virtual interpretations of museums. A new paradigm in human-computer interaction was developed – the Window On World, and in a preliminary appraisal the system was approved by museum professionals and the products – Audio Annotators – accepted by the public.

20th August 2000

M. Toby Harris | MA Product Design | Birmingham Institute of Art & Design | UCE

Primer

‘Ambient Technology for Museums’ is an investigation into applying the benefits of many modern technologies to enhance the museum goers’ experience. This report partners the research practice report, concluding the project from the conceptual to the concrete.

The term ‘ambient technology’ is used to describe the application of technology in a non-imposing and ubiquitous fashion, such that its benefits come readily and naturally to the user without detracting from their otherwise normal activities. The project seeks to apply this principle to the experience of visiting museums, realising museum-related research in a system suitable for reaching the public. In effect, this means increasing the scope of the present museum experience by incorporating the advantages offered by virtual[1] interpretations of museums.

Figure One Organisations involved with this project: Birmingham Institute of Art & Design (above), a faculty of the University of Central England (centre), and Birmingham Museums & Art Gallery (below)

Research Outcomes

The main research stage, concluded with the Research Practice Report, spanned from the identification of contexts to development of initial product concepts. The academic purpose was two-fold, firstly to explore the possibilities of merging the dynamic power of virtual worlds with the real one we inhabit and secondly to create a more humanised technology.

Three research threads were explored, broadly concerned with style (what aesthetic possibilities are there in applying ‘ambient’?), substance (what technologies can be made tangible?) and situation (what is implied by ‘museums’?). The main purpose of the research was to develop an understanding of all the technological possibilities in a museum environment and from this pool to devise the ‘ideal’ system, although the review went far beyond this and explored many cultural and modern design issues.

Two research propositions were formally concluded, one defining the design philosophy of ‘ambient technology’ and the other proposing a system upon which the design phase – and so this report – rests. These conclusions are included in this report as appendix one.

Report Objectives

This report will:

? State the definitive design proposal

? Justify the design process

? Amplify the considerations embodied in the proposal

It will not however document aspects of the project essentially unrelated to the design work such as use of modern media. These aspects will be concluded in a compendium of supplements including a use of media essay, a mapping of the project website and exhibition report.

Take the visceral thrill of the physical museum, left, with the dynamic power of the virtual museum, right, and develop as MA project…

Figure Two: The essence of the project

[1] Where virtual implies information and communication technology (ICT) based

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This chapter sets the conceptual framework for the 'Design Practice' phase. It revisits the design brief committed as a research outcome, and discusses the issues and opportunities involved in pursuing such ends.

Design Brief

The ‘Design Practice’ stage brief, defined at the end of the research phase, was as follows:

? Develop the Research Conclusion Museum System beyond its functional conceptualism

This will involve consideration of the stated Ambient Technology design philosophy coupled with targeted, practical, research as required.

? Realise this system into a set of product designs

This will co-evolve with the later stages of the system development.

? Facilitate public and professional appraisal of the designed system

This will require dissemination of the sense of the solution in a manner suitable for public use and professional scrutiny

This immediately establishes a set of design directions, which over the next two sections are synthesised with the other aims of the project and such issues as parameters of scope.

Figure Three
This main outcome of this project can be seen as a highly sophisticated development of Audio Guides.
This photo shows the hire booth at the Millennium Dome, Greenwich.

Factors & Contexts

As established at the research stage, this project embraces issues beyond those necessarily required for a museum system. The most obvious of these is the design philosophy ‘Ambient Technology’ which in essence aims to make technology deliver on our own – human – level. The full defining extract from the research report is included as Appendix One, but in summary there are two main issues with which to engage. The first is design for the periphery, which means products that we can be attuned to without attending to explicitly. The second is advancment of the input/output functions to a level more akin to the way in which a human would communicate in that context. While this aim is incorporated into the system design, the real effects will be felt on a personal product level, and so this will be a pivotal factor in this design phase of the project's development.

Separate to the design core of the project is a personal interest in the potential for modern media as a designer's tool. While the use of digital cameras, Photoshop and 3D software modelling is established and prevalent, there is still much unrealised potential, especially as the phenomena of 'convergence' of digital technologies increases.

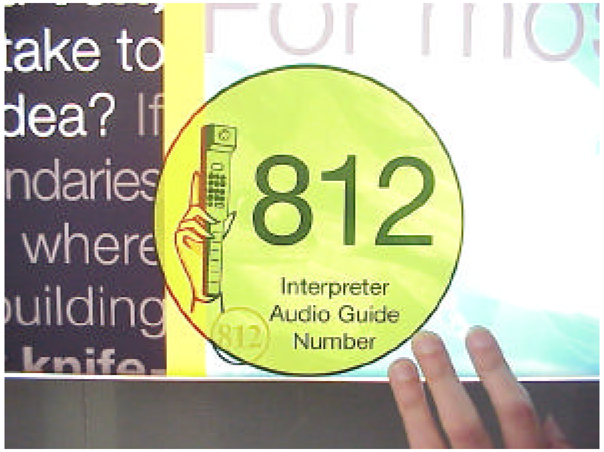

Figure Four
To use an AudioGuide, you type in the number attached to the exhibit and it then plays the corresponding commentary.

Scope

As defined at the project's inception, this is an investigation and as such requires definition of the boundaries and goals. Most importantly, it is not a design commission – with the outcome of a fully realised product – that rather is the central direction of this phase of the project. As such, the final designs will have a degree of suggestion, and this extends to the technical specification. Perhaps the most important consideration, then, after that of 'Ambient Technology' is the level of faithfulness the final outcomes will have to contemporary technological capabilities - the 'real' world. One of the tenets of this project is realism with current technology – the project falls to ideological dust if it is based on science-fiction. However, one is in danger of squandering the benefits of an MA environment – where it is possible to can look ahead and deal with shaping the future – if the year 2000 specification of component X is adhered to so rigidly that it compromises a design or feature. In dealing with this, the project has drawn a fine line in favour of an assessment of current feasibilities over what is commercially available. The aim is to keep the visionary aspect while keeping the results utterly believable.

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DEVELOPMENT

This chapter is split into the three main areas of development:

- ? Museum Integration Infrastructure,
  which incorporates the system as a whole.
- ? Physical Icon System,
  where the visitor and system become acquainted.
- ? Visitors' Product,
  which is the main design outcome of the project.

Each of these sections introduces the developments and design process behind the detailed outcomes presented in the subsequent chapter.

Museum Integration Infrastructure

The Research Practice Report stated a conceptual outline of the museum system to be detailed in the design practice stage. As the overall system is the order behind a system of products – comprising Visitors' Product (VP) and Museum Integration Infrastructure (MII) - the course of developing the system overview has had little effect on the system itself but rather trickled down into the details of the products. In addition most of the MII lies behind the scenes, so the only MII product that required designing was the VP's off-line support rack, and this is documented alongside the VP's design.

The critical question in the development of the conceptual system was the level of its sophistication, the repercussions of which extend beyond simple cost to complex issues such as sensor requirements. When investigating the commercial reality of some of the sensors and other components required, it was soon discovered that the novel applications required by the system were often not supported by suitable components available in the marketplace. An example of this is the looking glass's screen, its glass mounted monochrome dot-matrix lying within the scope of available LCD technologies[2] but lacking a commercial application. Similarly,

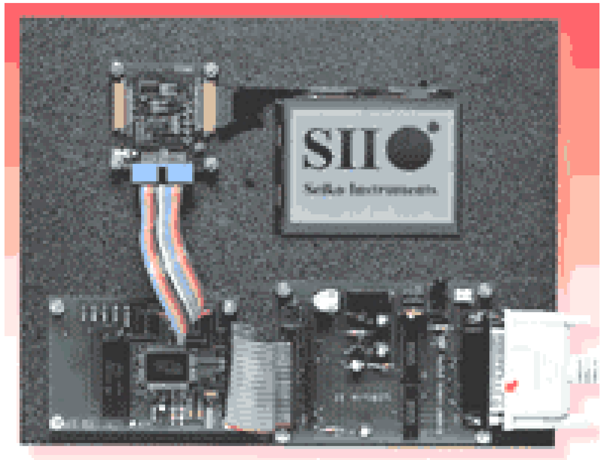

Figure Five
This is a COG LCD dot-matrix display, however it comes with backlight as standard.

[2] Cheap see-through LCD screens do exist, commercially available as Chip-On-Glass technology but only in segment form and not dot-matrix. Sophisticated full-colour see-through dot-matrix LCDs do exist, in such products as data projectors, but these are over specified and over priced for this project's requirements.

the accelerometers required to measure the looking glass's wand movements can be purchased commercially but only in vastly over-specified form and at corresponding cost[3]

As this situation eliminated the possibility of realisation of design work to a commercial level, the grounded freedom that the MA environment can provide was used, resulting in a reasonable outline of the most basic specification retaining the system's key features and suggesting a more extravagant, ideal system above this. On the surface, the differing sophistication makes no difference, as all that is changed is the underlying power of the sensing and software - the difference is manifest however in the aesthetics-of-use where the ideal system is more capable and communicable in its guide-cum-curator role.

Physical Icon System

As set out in the Research Practice Report, part of the MII was the Physical Icon System, where the museum visitors first come into direct contact with the system. Its function is to initialise the Visitors' Product to the visitor by generating a stereotype, refined with use, that is used to model the narrative's style and content. Physical icons are forms that represent something through

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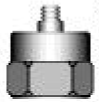
[3] Whereas all that is needed is a small weight on a semi-rigid stalk with strain gauges stuck to it (and a strain gauge need only be a long electrical track laid into a plastic film), which could be craft assembled for less than £5 compared to the £200-300 of commercial accelerometers. Such accelerometers can be found though RDP Electronics, of Wolverhampton: eg the PEC SG Miniature Piezoelectric Accelerometer (£288 ex VAT) – details at http://www.rdpelectronics.com/acceleration/pec-sg.htm

RDP GROUP

Model PEC-SG Miniature Piezoelectric Accelerometer

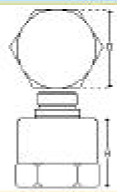


The RDP Electronics model PEC-SG accelerometer uses piezoelectric technology and has a very wide natural frequency range and a flat response over a wide temperature range. It is designed for use in rough industrial and research applications such as impact, jet engine and acoustically induced acceleration testing, and to measure acceleration, shock and vibration in a wide range of applications.

Piezoelectric acceleration transducers using voltage mode, require a constant current excitation from the amplifier. Please contact RDP Electronics for advice on such devices.

Due to the fact that PEC-SG transducers do not have a range as such, they are appropriate for acceleration, shock and vibration applications where the approximate amplitude is not known. The maximum range of the sensor is 2000g, limited by the maximum vibration that the sensor will tolerate.

All dimensions are in millimetres unless otherwise stated



H	D (across flats)
10.16	9.4

Transducer performance

Transducer Sensitivity	Mounted Natural Frequency	Transverse sensitivity	Frequency Response	Output Impedance	Transducer Resistance	Strain Sensitivity at 250 microstrain
5mV/G (nom)	50kHz (min)	5% max	±5%, 2Hz to 8kHz	<100 Ohms	0.5G Ohm (min)	0.5 G equivalent

Environmental

Operation Temperature	-40 to 91°C	**Shock**	3000G peak, half sine
Vibration	2000G peak	-	-

Electrical

Electrical Termination (mating part supplied)	10-32 UNF Coaxial Connector	**Earth (ground)**	Connected to case
Current	2 to 10 mA	-	-

Mechanical

Case Material	Stainless Steel	**Sensor Weight**	4 gms
Design	Shear	**Mounting**	Adhesive (with low shear strength)

their physicality, but in this case they are electronically coded so that the system can read the visitor's selection and, treating them like answers to a novel closed response questionnaire, build a user stereotype. This was chosen first as it introduced the system in a non-technological and interesting way, which was especially important at the visitor's first contact; and secondly as it allowed interesting possibilities with the linking of the icons to the guide product. However, during design development it became clear that the user should be led into using the guide, and through debate with the whole MA course it was decided that the visitor's experience would benefit best from the bringing together of these two roles without the added complication of a separate sub-system. Therefore the concept of a 'Taster Tunnel' was developed, where the user would be progressively led through the use of the guide and in doing so would reveal to the guide the facts required to construct their initial stereotype. This not only combines the two roles into one process but in doing so reinforces the use of the guide rather than adding an extra layer of complexity.

Visitors' Product

The visitor's product is the main design outcome of this project, and essentially all the benefits of the system as a whole rest on the visitor's acceptance of the product. The designing of this product, both conceptually and in detail, formed the main thrust of the design stage.

Initial concepts from RPR

The design process began as the culmination of the research stage with an initial design proposal. It was quickly realised that there were two important issues in the development of such a product, namely its fit – as the product becomes a personal item how it fits to the person becomes critical – and the development of gestural input – following from the ambient technology design ethos. 'Fit' was addressed by the initial concepts shown in figure seven.

The noteworthy characteristics of these initial concepts are the incorporation of headphones and the circular screen. Using headphones rather than some form of handheld speaker, as per Audio Guides, is a requirement of the system as it will start narrating of its own accord rather than wait for an overt prompt. Headphones also comply with the system's intended minimal presence in the museum space, keeping the experience personal and not affecting other nearby visitors. The circular screen used in three of the concepts reflected a desire to break with technological convention and provided a magnifying glass aesthetic.

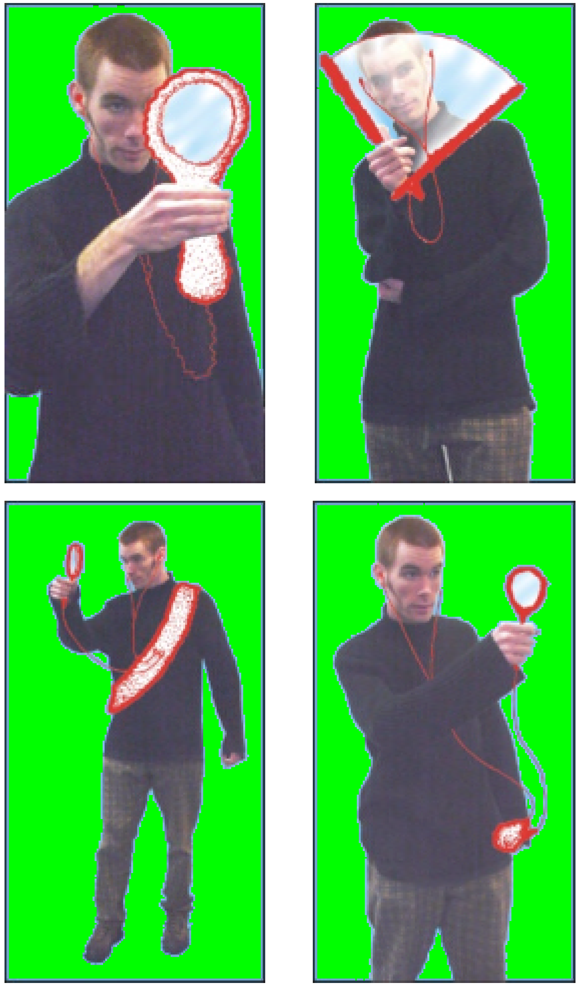


Figure Seven
The initial concepts from the Research Practice Report conclusion. Top left: 'Fat Boy'; Top right: 'Oriental Fan'; Bottom left: 'Sash'; Bottom right: 'Stone'.

Gestural issues were quickly resolved with the idea of a magic wand which could be manipulated for all the basic functions such as ‘stop’ and ‘next topic’ and could be used as a pointer to glean information about details within the exhibit. When combined with the circular screen the very appealing metaphor of a looking glass developed: something that you look through to receive further information (the visual annotation) and use to investigate objects (the gestural exhibit interrogation interface).

Weight proved a key factor in evaluating the concepts, as the all-in-one units were deemed to be too heavy to use over the length of an entire museum visit given that to be used must be raised to eye level and precisely positioned.

Considered Concepts

The exploratory, diverging, phase of the design process was concluded with the considered concepts. Informed by feedback from the research stage concepts, a range of final concepts was developed that embodied a far broader review of the possibilities and issues.

Through sketching, the creative directions were combined and ultimately consolidated in an ‘aesthetic exploration’ concept – a product embodying the array of developed ideas. This is shown in figure eight.

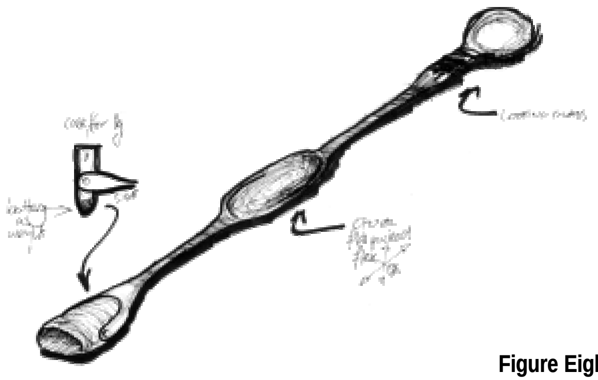


Figure Eight
The aesthetic exploration concept.

Inspired by this ‘far-concept’ product, four sensible variants were then devised. It was also realised that given the worn nature of these products further evaluation could not be based on paper alone, and so some form of sketch modelling was required. The four variants were:

1. Strap – The nearest to the aesthetic exploration concept, the emphasis being on flexibility of configuration.
2. Sash – A simple concept, effectively an evolution from its namesake initial concept.
3. Shoulder Pad – A balanced strap that hangs over the shoulder.
4. Bag – A less minimal alternative to the sash.

To evaluate these considered concepts and so choose the concept for detailed product development the whole MA course was involved, receiving a presentation and contributing to a feedback session. Through the diversity and insight of those involved with the course, a wider appreciation of the issues inherent in the product concepts was gained.

Although at the time one concept was chosen above the others, it was obvious from the debate that this wasn't a clear-cut choice. On subsequent consideration of the arguments, it was decided to develop three concepts in parallel, each suiting a certain museum/visitor context best. These concepts are then the siblings of the Visitors' Product family, sharing the same genes in the form of shared system components and aesthetic.

The three chosen concepts, were the shoulder-pad, sash and bag. The shoulder-pad concept takes advantage of the museum's conditions of use but might seem inappropriate in a more conservative museum, whereas the bag concept seems ideal for such museums and their patrons as it cloaks the 'new' with a veil of an accepted product. Following similar arguments,

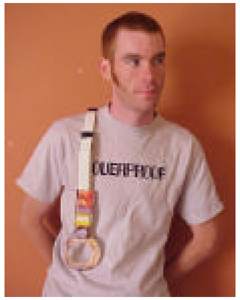
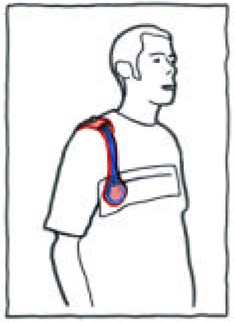



Figure Eight (left): The considered concepts (except sash).

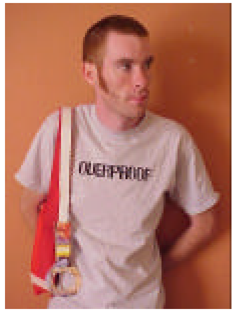
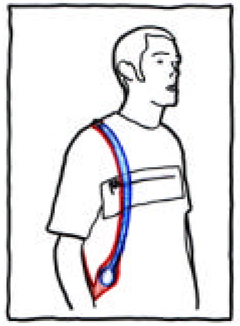
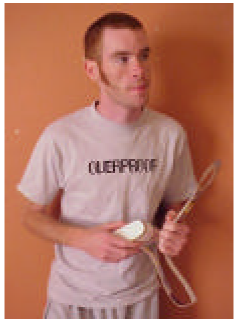



Figure Nine (right): The chosen concepts.




the sash forms a good common denominator and has the added benefit of being probably the simplest, and so the cheapest, of the range.

Another benefit of this approach was that it gives a certain democracy to the way in which the technology is received by the wider world, disconnecting the system's (more objective) underlying power from its (more subjective) exclusive physical form.

Evolution of Design

With the family of concepts devised and the idea of shared components set, a strategy to reach a final design proposal was reached. As developing the electronics – or even a simulation of the electronics by the sensors and screen surreptitiously being interfaced to a hidden computer – was impossible under the remit of the course a fully working prototype would be impossible. With this established, a range of methods and mediums were chosen to develop and illustrate the different aspects of the products. For the shared components, all small scale assemblies whose character lies in the details, computer 3D modelling was chosen which would also yield photo-realistic renderings of at least some of the product – an important consideration when convincing the public of the possibility of such a system. For the development of the overall concepts, detail was far less important against the overall properties of the design, allowing sketch models of varying finish to prove the concept. A lower level of finish meant that the models were significantly less fragile than conventional presentation models and so could be handled by the public.

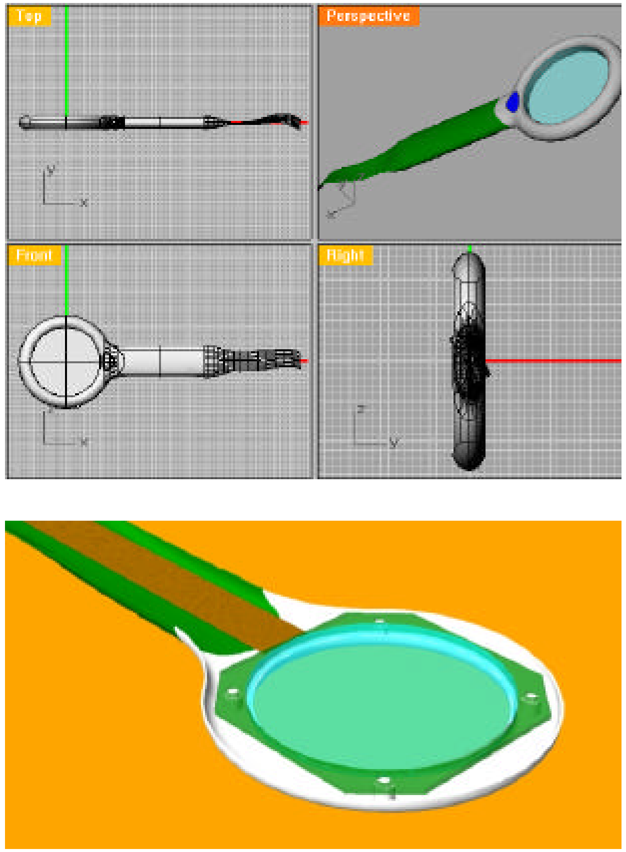


Figure Ten
Models in the computer 3D design process: top, the first looking glass; bottom, an early development of the final exterior form.

To progress to such outcomes the design process followed the method of final presentation: The only way to expediently model the unrestrained 3D design of a detailed component is through such computer modelling, and in efficiently highlighting the pros and cons of the worn designs sketch models had already proved their success. Despite the increased demands for producing a model over other methods such as drafting a drawing, the feedback generated by sketch models far outweighed the extra effort, and resulted in great leaps of design sophistication. This was especially important in the development of the shoulder-pad concept, the bag and sash requiring less design effort. Full details of the design process are available on-line in the 'product' section of the project website[4].

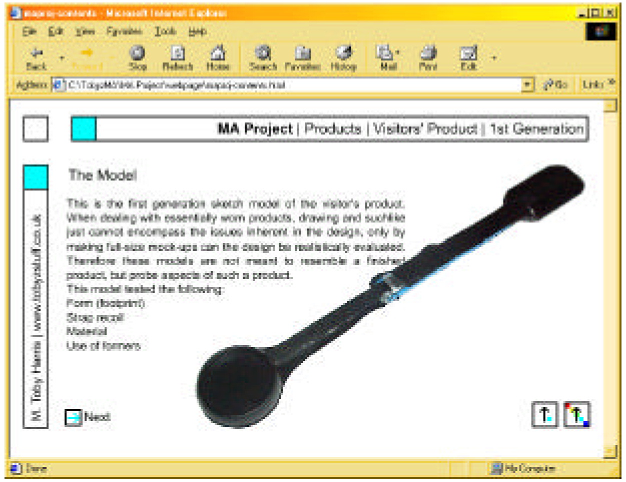
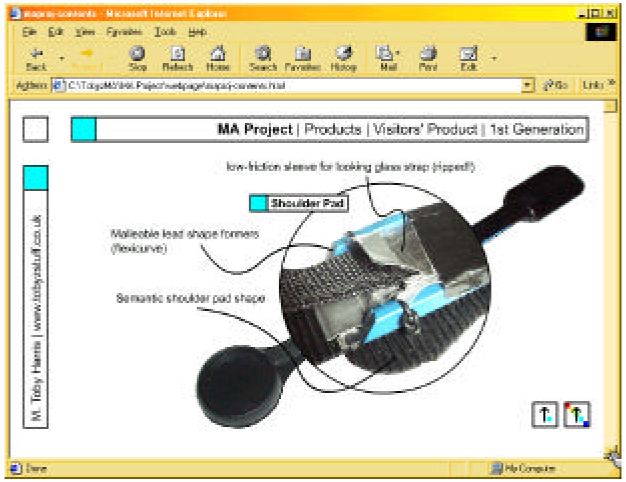


Figure Eleven
Project website screenshots showing further elaboration of the design process. This is the 1st generation 'material qualities' sketch model.



4 Available at www.tobyzstuff.co.uk/maproject or through www.biad.uce.ac.uk/research/museums (student prototypes).

Visual Annotation Research

The Museum System defined as a research conclusion introduced the notion of a visual-clue annotator to the audio narrative:

> *Whenever the narrative makes reference to a physical feature, the looking glass is used to identify the feature and visually annotate the narrative: looking through the looking glass display effectively superimposes graphics onto the exhibit, with correct alignment by the visitor. The technologically updated looking glass itself does the majority of this by virtue of its size, and accurate alignment is achieved through a framing display consisting of a silhouette mask.*
>
> ***Research Practice Report, p41***

Figure Twelve
By experimentation with white-board pen and ID card sleeve a feel for the visual annotation issues was developed.

As far as is known, this is a completely novel application – indeed a new paradigm in human-computer interaction – and as such is untried. While a very basic proof of concept was conducted at the research stage, there are a number of issues surrounding the concept that need to be resolved before attempts at mass-acceptance. Consequently, an ergonomics experiment was devised to investigate such issues. It is reproduced in part here:

> ***Introduction***
>
> *This document outlines an ergonomics experiment to resolve issues around the 'Window on World' concept. This visually annotates an audio-driven narrative, through a 'Window on World' which superimposes images onto the seen world. Where this differs from conventional augmented reality is in that it is oriented towards a more mass market and workable low technology direction, the simple result of which is a handheld transparent screen. While*

looking through this objects can be visually annotated, with correct alignment achieved through the user registering the augmented images by framing the screen.

This concept rests on the premise that people can usefully fuse visual elements at differing distances, which this experiment will explore and establish the boundaries for useful configuration.

The Problem

Given the situation of viewing the world through a selectively transparent display which can be used to visually annotate a heard narrative about the surroundings, the following issues need investigation to resolve the optimum configuration of such a device and the corresponding bounding conditions for effective use:

? *Ability to frame – ie align predefined displayed images of the object with the object*

? *Effects of visual angle – ie the relationship between viewing distance and relative size of screen and object.*

? *Stereoscopic issues – ie looking through one screen with two eyes*

? *Off-centre performance – ie ability to fuse the set image and object when distorted through altered perspective.*

? *Display strategy – ie differences in indicator and blocking style*

Apparatus

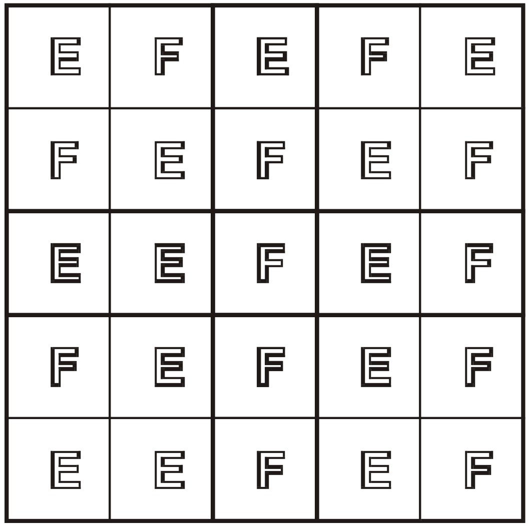
'Windows': Small (40x40 mm) Medium (70x70 mm) Large (100x100 mm)

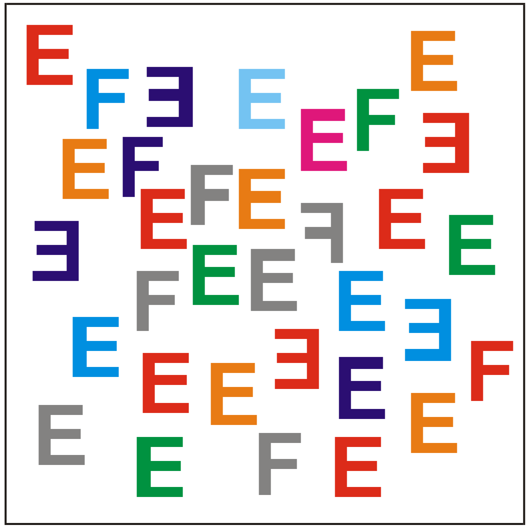
Posters: 1x Painting (A2) 3xGrids (A5,A3,A1) 1x E/Fs (A2)

Arrange posters along a plain wall. Mark lines from wall on floor to form a ruler.

Method

For each candidate:





Show posters and ask

"Please stand at a comfortable distance from the posters on the wall"

Measure distance from wall

Introduce displays and state/demonstrate

"This is a window on the world. I have a selection of different sizes and different images in each window which tally with parts of the posters on the wall. By looking through the window at a poster, you will see a frame with which you can align the window to the poster. Now the arrows on the window will point to details I have selected.

First of all I want to quickly give you a range of window sizes and see which you prefer"

Hand over window (medium/large/small), get candidate to comfortably frame window with poster.

Measure arm extension and distance from wall

From now on use medium window.

<… a series of similar tests, omitted here for report brevity, are conducted which quantify the visual angle subtended through the looking glass against the performance of aligning various graphics inserted into the window against their accompanying poster… >

Measure settled distance from wall.

Using the medium window ask

"Now remaining at the same distance from the poster, try angling around towards the wall until the aligned image becomes unusable.

Unfortunately, this experiment fell foul of the volume of detailed design work required to generate the project outcomes and so the detailed analysis remains to be conducted. However, a cruder proof of concept was still essential for the validity of the project, and so a simple test

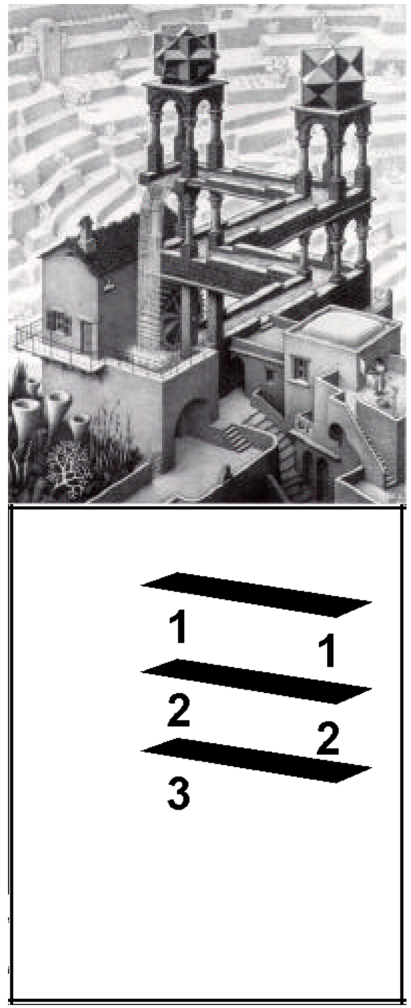


Figure Fourteen: The painting intended for the experiment and a WOW graphic illustrating the impossibility of the storeys. Previous work has shown the suitability of this painting.

was conducted in the public appraisal conducted at the end of the investigation. This did satisfy the concept as workable, but a fuller study is required before progressing the concept further.

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This chapter details the outcomes of the Ambient Technology for Museums investigation. The designs are detailed in self-contained format, and the report concludes with both public and personal appraisals.

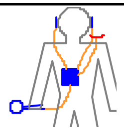
Definitive Museum System

The conceptual museum system was defined in the Research Practice Report and still gives an eloquent overview; it can be viewed in the appendices. The following definitive system takes a more detailed piecemeal approach.

The 'Museums Through a Looking Glass' Kit

A museum installing the system – 'Museums Through a Looking Glass' – would receive the following:

'Audio Annotators' (otherwise known as Visitors' Product)

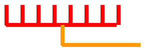


Description: The guide product given to the visitor; available in three models.

Quantity: As per demand. A range of models can be offered.

Refer to Design Products section.

Recharge Rack (otherwise known as VP Rack)

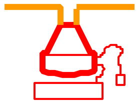


Description: Off-line support receptacle for the Audio Annotators.

Quantity: One element per Audio Annotator, built in series.

Refer to Design Products section.

Museum Database

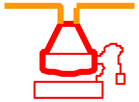


Description: The central computer with virtual museum database and visitor history store.

Quantity: One

Desktop PC, Custom software, Allows database updating on the fly.

Web Server



Description: Custom world-wide-web page generator and server.

Quantity: One

A consenting visitor's history is passed to this WWW server which upon access generates them a website based around their visit.

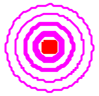
Security Detector

Description: Detects Annotators passing through gap.

Quantity: One

The annotators have a security tag embedded in them which triggers an alarm if passed through the detector.

Location Markers

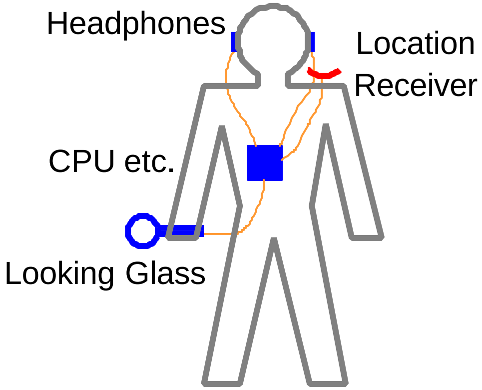


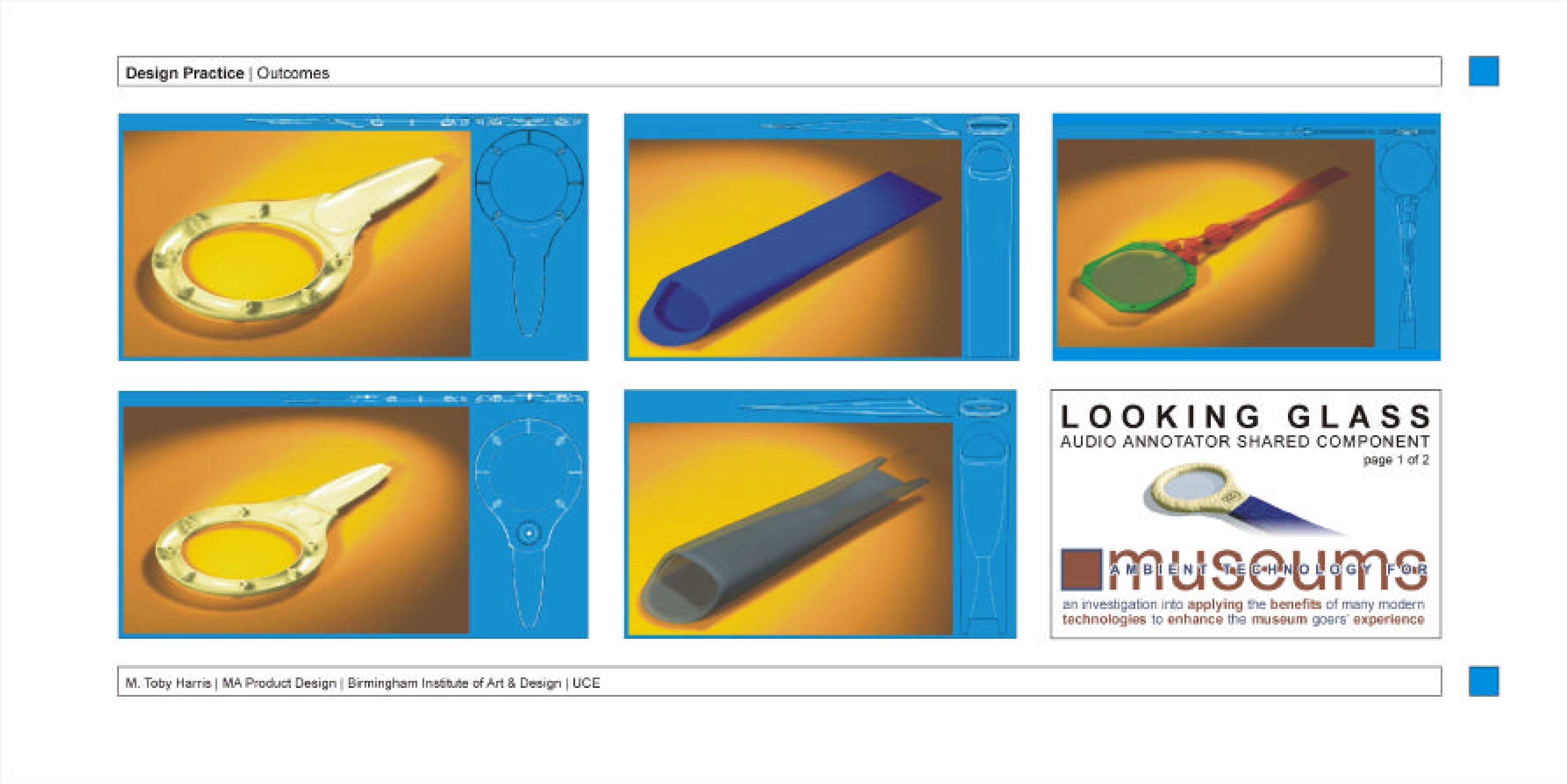
Description: Ceiling mounted infra-red transponders.

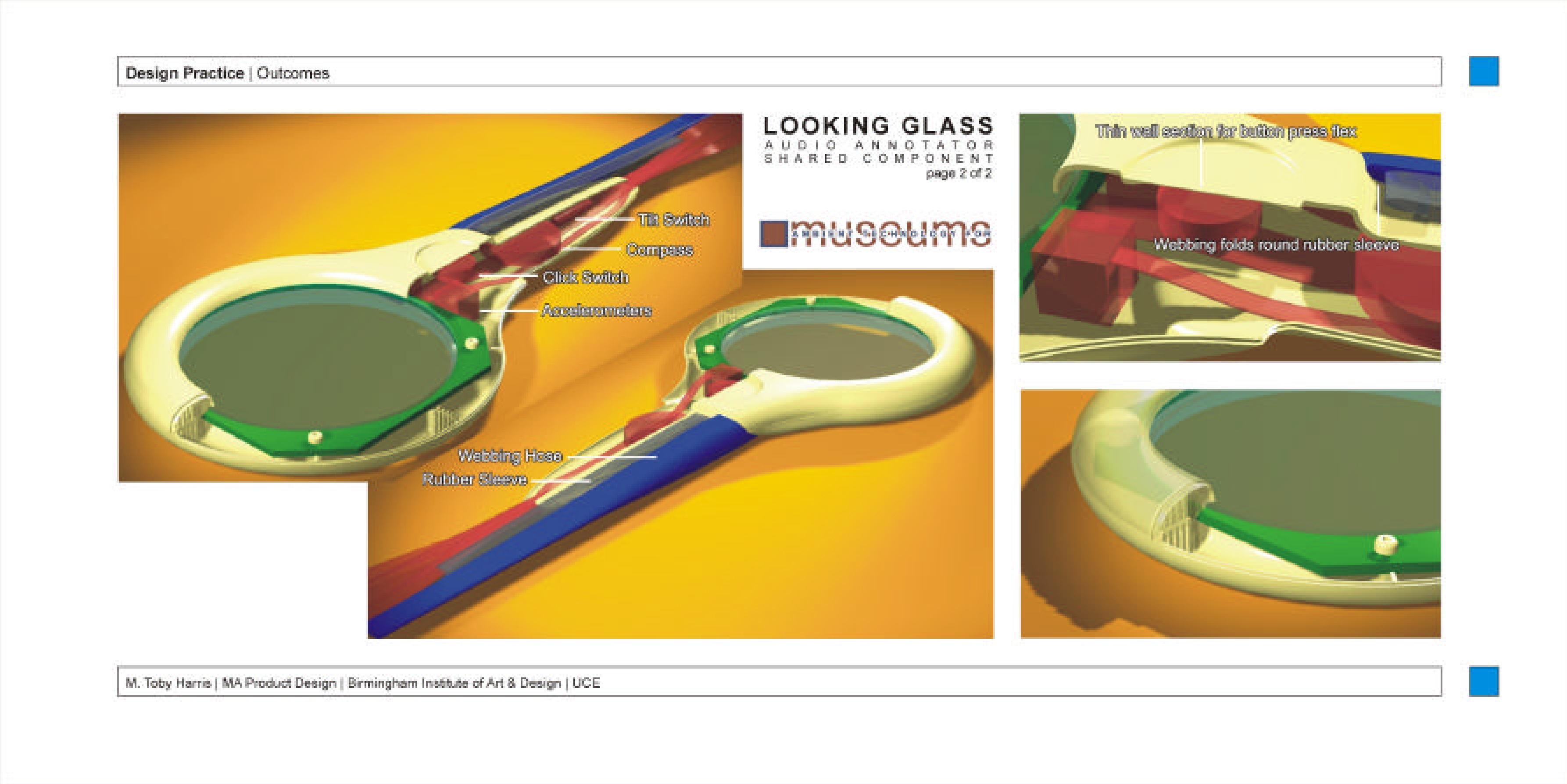
Quantity: One per exhibit

Autonomous Infra-Red coded transmitters, includes battery state information which is passed to the main computer via the AA.

The Audio Annotators are mobile devices which act as museum guides and require the rest of the equipment installed around the museum – forming the Museum Integration Infrastructure – to support their operation. Each Audio Annotator, in all three different models, has a main unit containing the CPU etc., a Looking Glass, Location Receiver and Headphone socket. The location receiver lies on the top of the visitor's shoulder. The actual headphones can be supplied by the visitor, ie from a personal stereo or mobile phone hands-free kit (with standard jack), with the museum keeping a stock as per airline practice.




Design Practice | Outcomes
LOOKING GLASS
AUDIO ANNOTATOR SHARED COMPONENT
page 1 of 2
AMBIENT TECHNOLOGY FOR
museums
an investigation into applying the benefits of many modern technologies to enhance the museum goers' experience
M. Toby Harris | MA Product Design | Birmingham Institute of Art & Design | UCE


Design Practice | Outcomes
LOOKING GLASS
AUDIO ANNOTATOR
SHARED COMPONENT
page 2 of 2
museums
Tilt Switch
Compass
Click Switch
Accelerometers
Webbing Hose
Rubber Sleeve
Thin wall section for button press flex
Webbing folds round rubber sleeve
M. Toby Harris | MA Product Design | Birmingham Institute of Art & Design | UCE

The Museum Integration Infrastructure would be arranged as shown diagrammatically in figure fifteen. The system is visible in the foyer area, where the hire desk, 'taster tunnel' and support office are situated, but once in the galleries the presence is effectively invisible with the small location marker devices mounted high out of sight (and reach).

The Recharge Rack is the system's furniture presence in the hire desk area, which acts as the Audio Annotators' off-line receptacle, not only recharging the device but facilitating upload and download between the AA and the Museum Database computer. This is a standard desktop PC upon which the virtual museum model is maintained and museum usage statistics automatically compiled. It also monitors the state of the Location Markers' batteries, relayed via the AA. A Web-Server is also networked to this computer, as part of the visit follow-through explained below.

The Taster Tunnel is where the new users acquaint themselves with their annotator and vice versa. It consists of a carefully graded series of paintings which introduce with each work a feature of the annotator and glean a factor of the stereotype from the user. Once through, the visitor's annotator is fully functional and will continue refining this stereotype with information obtained and inferred from the visitor's actions.

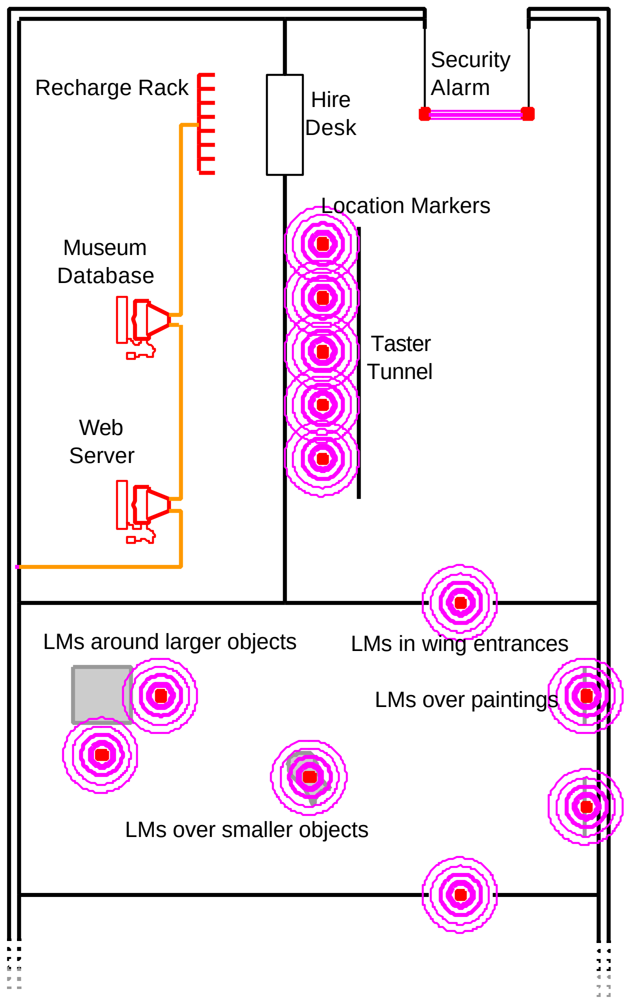


Figure Fifteen: A museum with MII installed.

When an annotator moves underneath a location marker, it is illuminated with the location identification signal, resulting in the HyperAudio technology inferring whether the user is 'standing still', 'approaching', 'leaving' or 'passing through' and using this as an implied input. The HyperAudio technology also reacts to explicit input through the wand, and is also adapted to drive the WOW interface. The adaptive hypermedia engine works as follows:

> *Both implicit and explicit inputs compose the interaction history, which represents a summary of the visit (both physical and virtual) up to that moment. It plays a very important role in the adaptation process since HyperAudio refers to it when planning the next presentation, deciding, for example, to not play a piece of content already presented or to introduce a comparison with an object already seen. The system dynamically creates a personalised presentation. This means that no fixed presentation exists in the system, but rather they are composed on the fly on the basis of a suitable subnet of contents. A presentation is composed of:*
>
> ? *a sequence of audio files that are played through the headphones;*
>
> ? *a set of relevant links worthy of future exploration;*
>
> ? *an image related to the object described or an oriented map displaying the user's current position.*
>
> *HyperAudio hypertextual presentations realize both link and content adaptation since only one part of the information space is accessible at a given time and the content of each presentation step is dynamically organised to best fit the present communicative purpose.*
>
> *From* ***HyperAudio: Location-Awareness Adaptivity***[5]

After the visitor leaves the galleries, they return the Annotator to the hire desk where they are informed of the possible visit follow-through. The anonymous visit history generated by the annotator can be used for follow-up purposes, most economically through web-page generation, but other possibilities include targeted mailing lists or simple factsheets. While the history upload is anonymous – and each history adds to the detailed statistical museum usage model – with the visitor's consent the history can be stored under some form of ID so that on a repeat visit the annotator can be re-initialised to the way the visitor left it. As the user model refines from the initial stereotype with use and the narrative has the ability to cross-reference with seen exhibits, this is an extremely powerful feature.

[5] Narrative, 5th paragraph. Available at http://ecate.itc.it:1024/projects/hyperaudio

System Sophistication

The system outlined so far represents the core, and can be developed further through the details and beyond. Therefore in defining the system further, two possibilities will be outlined, representing the basic and ideal systems, between which it is possible to interpolate. The basic system is serviceable and a huge advance on anything seen before in the museum world – and other environments – whereas the ideal system is much more interactively developed and fully embodies the ambient technology ethos. The difference between the two is largely down to sensing requirements, for instance the basic requires a few 'clunky' sensors whereas the ideal has virtual-reality style 3D tracking of the looking glass around the exhibit.

System Aspect	Basic System	Ideal System
Exhibit Interrogation	None	L'Glass as selection pointer
Map	Non-orientated	Continually reoriented
Interest tagging	Button	Also MP3 Dictaphone
WOW display	Non-orientated	Continually reoriented

Visitor-Annotator Interaction

The system has been described in hardware terms, but not in behaviour. Behavious is especially important to this project, with its humanising aim towards technology. The excerpts throughout this section are from a main paper on HyperAudio technology: 'Content Adaptation for Audio-based Hypertexts in Physical Environments'.

Narration Navigation

At the heart of the system's premise is a personal product that requires little overt control, having a sufficient degree of awareness of its context of use to feed the user's interpretation needs without prompting. The HyperAudio technology is a significant step in this direction, and together with the ultimately simplistic sensing ability of the product it depicts a good representation of the state-of-the-practicable. The control requirement lies then in shaping the narration rather than a complete control method. A magic wand metaphor has been used to implement this, meaning that control is through instinctive human gestures.

The system should adapt its behaviour according to a user model dynamically updated interpreting either the user explicit interaction (clicking on the palmtop screen) and his movements.

Explicit interaction is through the wand and not a PDA screen, and the looking glass might add another implied input for the system to consider: an 'interested' state with the looking glass lifted. This can be used for further refinement in designing for the periphery, as outlined in the ambient technology essay.

W O W

The key innovation of the system is the Window-On-World (WOW) which is able to visually annotate the audio narrative, transforming its effectiveness. A novel interpretation of the highbrow research topic 'Augmented Reality', the WOW apparatus is unprecedented in its simplicity. The key is the solution of the registration (correctly aligning the generated image onto the real world) problem: simply by the user framing a silhouette. So whenever the audio narrative refers to a feature of the exhibit the user has the option of lifting the WOW display, aligning the displayed silhouette, and seeing the feature singled-out through the screen. The benefits of HyperAudio with a WOW device are illustrated in the following annotated excerpts:

The system should provide information to help direct visitor's attention to and stimulate interest in the objects ([Bitgood and Patterson1993], [Boisvert and Slez1994]). This means that messages offered to the user should directly refer to what the user is seeing (also exploiting appropriate linguistic forms, e.g. deictic references as ``this object'' or ``the object on your left'') and should help the user to identify the object described (and its importance) among the others displayed.

Adding the WOW takes the realisation of this to a new level: by directly visually annotating the audio it first uses the favoured human method of singling something out, ie pointing, and secondly frees the narrative to concentrate on stimulating interest.

M a p

If the looking glass is held parallel to the ground, it transforms into a map of the locality, centred around the Annotators known position (either gallery or exhibit). With the ideal system, this is further enhanced by constant correct orientation with the museum space through electronic link to a compass-like device.

The system should integrate information with directions that help the user orient himself in the physical space (e.g. how to reach an interesting object, a friend, the exit, ...) and decide where to go next.

Interest Tagging

If a visitor becomes especially interested in an exhibit, they can record this for later by pressing the Annotator's only button, or additionally record a verbal message with the ideal system. They can be reminded of these exhibits before leaving the museum, allowing informed browsing through the shop and further information resources; the virtual tags are used as overt input when generating the custom web-page, from which the dictaphone messages can be downloaded.

Exhibit Investigation

While not implemented in the basic version of the system, the exhibit investigation possibilities of the ideal system form one of the best features of the system. When the resolution of known objects increases from exhibit-floorspace level (registered with the IR location markers) to objects-within the-exhibit accuracy (registered through VR style 3D tracking) the looking-glass metaphor created by housing the WOW in a such a shape becomes complete: not only does looking through the looking glass reveal information, but the looking glass can be used to search for detail – or information. With the wand this forms a completely gestural, instinctive interface of considerable power.

> *The system should not overwhelm users with information ([Finn1985]), though providing opportunities for the interested visitor to easily find new and more detailed information on a subject ([Serrell1996]). Although this issue is relevant for presentation systems in general, it becomes crucial when the user is physically moving through museum rooms and standing in front of exhibits. In fact, physical tiredness might appreciably affect user's attitude toward long commentaries, as well as his satisfaction and learning.*

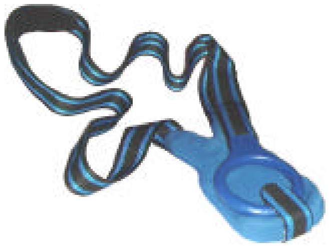
WOW eliminates the need for complex audio directions so the information overload is greatly reduced. The exhibit investigation capability, or rather the looking glass metaphor further enhances the experience by providing an extremely natural and minimal method for visitors to navigate the information space.

Design Products

The design products of this project are the visitors' product family, named Audio Annotators, and their recharge rack. There are three Audio Annotator models, which are built around a common functional base realised in the form of shared components. The designs exist on two levels, the shared components being CAD modelled with a fair degree of detail while the family's models are schematically outlined in conjunction with the physical models made. This arrangement gives the design work a necessary level of believability and depth of design effort while hopefully avoiding a reception to the project that is derived solely from an appraisal of the finish quality of the products as presented.

The products are:

Audio Annotators



Regular

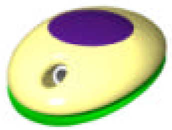
Classical

Techno

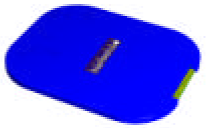
The Audio Annotators share these common components:

Audio Annotator Shared Components

Looking Glass (WOW & Wand)

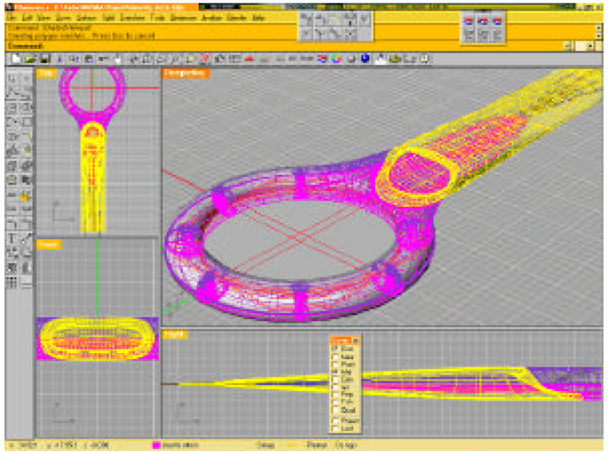


Comms Pod



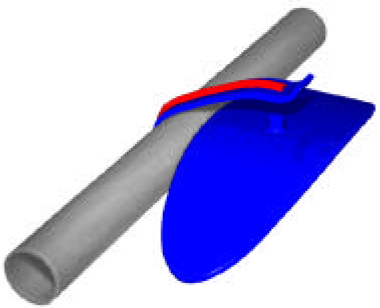
CPU Housing

Battery

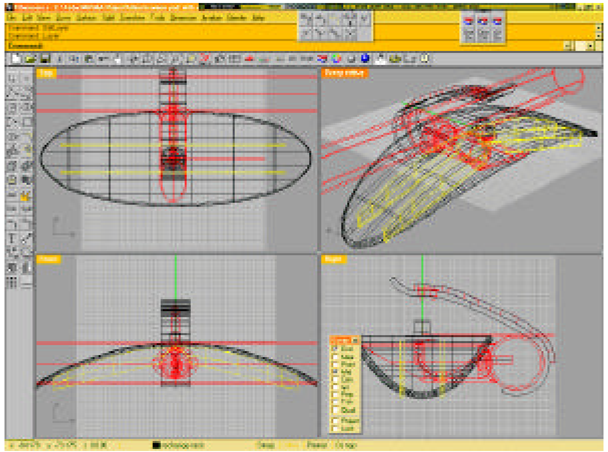


And finally while off-line dock with:

Audio Annotator Off-Line Support



Recharge Rack



The Audio Annotator Family

The three AA models are different interpretations of the same specification for differing contexts and ends. The shared specification is:

? Mount the infra-red receivers in such a way that they always are in view of the ceiling.

? Provide a headphone outlet.

? House the battery and CPU.

? Attach the Looking Glass.

The evolved designs deliberately form a family, so that beyond the same internals there is a shared visual aesthetic and aesthetic-of-use. These shared genes were:

? Webbing strap continuum: the visual key that holds the design together is the webbing strap that runs throughout, blurring the boundaries between the product's different components. Use of a flat strap as opposed to round cord/cabling also means that the looking glass strap is hard to twist around, this helps the looking glass to remain facing in the right direction, an important consideration. A width of 40mm was considered wide enough to aesthetically and mechanically carry the form of the product yet narrow enough to comfortably expand into a handle.

? Oval shoulder pads: Given the requirement that the IR sensor remain on the top of the user's shoulder there is a strong incentive for the shoulder pad design to have a semantic

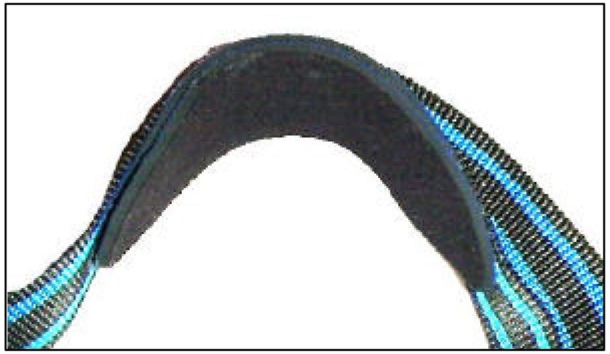


Figure Sixteen (top): Note the way the webbing strap mechanically and aesthetically holds the product together.
Figure Seventeen (below): The shoulder pad shown here on the Regular model is that same throughout the family

clue as to its wearing, and the oval design and choice of material provided this. In addition the shared shoulder pad simplifies the design of a family-wide recharging rack.

? Fabric & rubber surface: The touch and feel of the Annotator has to break any distrust at first touch, so a warm and pleasantly tactile exterior is essential in distancing the product from the learnt cynicism towards 'black boxes' and harsh electronic products of office efficiency.

? Soft and rounded: In a similar vein to the above, a soft and rounded overall form will help to give a good first impression to the visitor, and is also a literal way to make the product seem more humane – after all, we are not hard and rectilinear.

? Sealed exterior: Aesthetically, a sealed exterior hides any indications of conventional technology and practically, this means that there is less to be damaged, both in terms of vandalism and wear and tear. The only exception to this is the headphone jack.

Figure Eighteen
Surface qualities – The production model would have Nextell rubberised finish. To model this fabric was sprayed with plasticised paint. The looking glass should have this same finish, rather than the hard finish seen here.

Regular Audio Annotator

The Regular AA represents the simplest interpretation of the visitors' product, and is identifiable by its sash configuration.

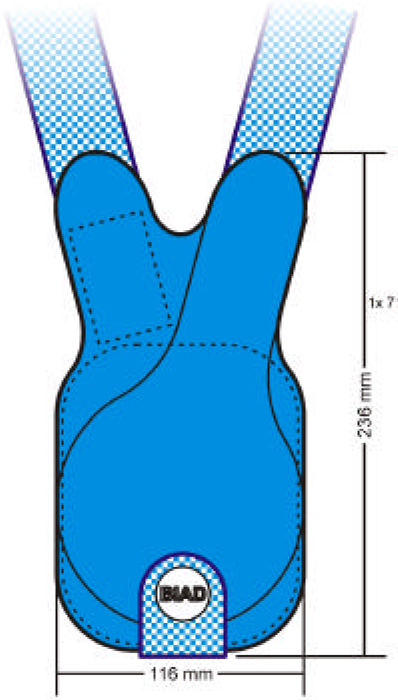
Advantages	*Disadvantages*
Cheap	One size gives one fit
Light	Straps get tangled
Relatively foolproof	Worn handed (must hang to the right)

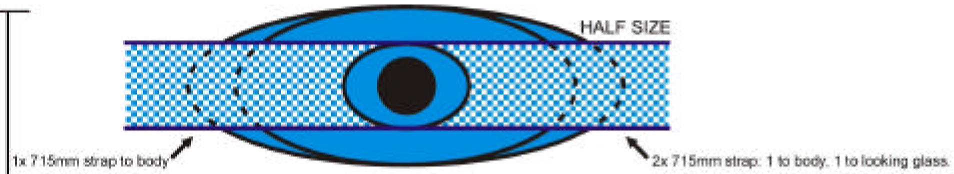
Figure Nineteen
The Regular Annotator's main body.

Design Issues: The main parameters in its design were the looking glass strap length of 715mm – the 95th percentile maximum shoulder to grip length – and the size of CPU box. Together, these gave a minimum sash loop length of 1430mm if the CPU housing was brought up as high as possible, resting alongside the looking glass. This makes the product much more compact and elegant than the initial concept but also handed. Any attempts to remove the handed nature resulted in a product that had lost its transparent simplicity. The handed effect only means that the CPU housing has to sit on the person's right hand side. The solution to this problem lies with devising a semantic prompt to ensure this.

The main problem with the Regular Annotator is that the looking glass strap length – the 95% percentile male's arm length – forces the whole product to similar dimensions, effectively fitting it to the biggest torso expected to use it. This means that for a personal with a height of c.6' the effect is as intended, with the looking glass hanging by the hands giving the effect of shooting from the hip, but a 50th percentile female will have to reach down towards her thighs. For small children, this becomes their feet. The solution to this is to produce a range of sizes such as Child, Adult Small and Adult Large, which owing to the model's simplicity will affect the manufacture process little.

Figure Twenty: The Regular Annotator


BIAD
236 mm
116 mm


HALF SIZE
1x 715mm strap to body
2x 715mm strap: 1 to body, 1 to looking glass.


R E G U L A R
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Classical Audio Annotator

The Classical AA is the natural development in addressing the adjustability and handed issues in the Regular model, and is identifiable by its bag configuration – which through semantic considerations was the original spark of creation.

Advantages	*Disadvantages*
Adjustable	Straps get tangled
Provides storage	Manufacture complications
Non-technology appearance	Susceptible to fashion judgements

Design Issues: The concept was created as an exercise in wolf-in-sheep's-clothing: by veiling the new technological product in an established non-technology form it was hoped that the product could gain cross-cultural acceptance. The flip-side to this is that the product loses its truth to function; because it is fashioned it becomes susceptible to fashion judgements. The concept also is the logical solution to the engineering out of the handed and adjustiability issues with the strap concept: the looking glass cannot then twist around the body and so lies instead on the forward face of the bag; accommodation of the mechanism and surplus strap must be made. Adjustment of the strap length also necessarily introduces some awkward design, and so manufacturing complications. This is caused by the fact that only the back strap can become adjustable due to the extra looking glass strap at the front. This has two repercussions, first that the concealed cabling has to be re-routed away from its natural path down the back so as not to get damaged in the mechanism, and secondly that the shoulder pad has to remain on top and

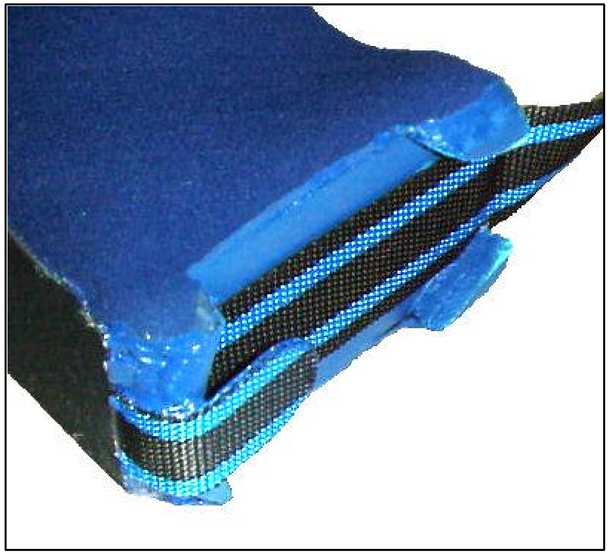


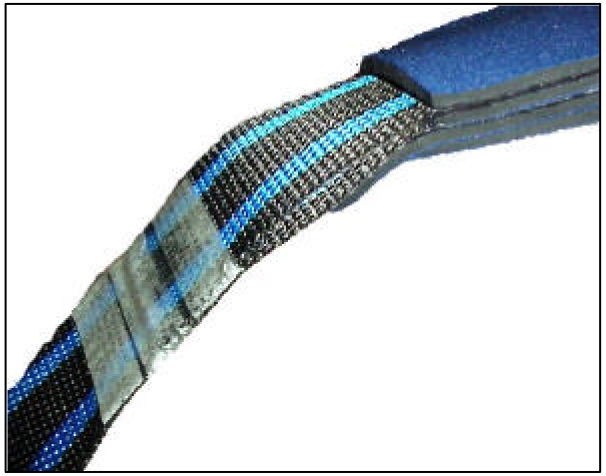
Figure 21: The looking glass holder on the forward face of the bag

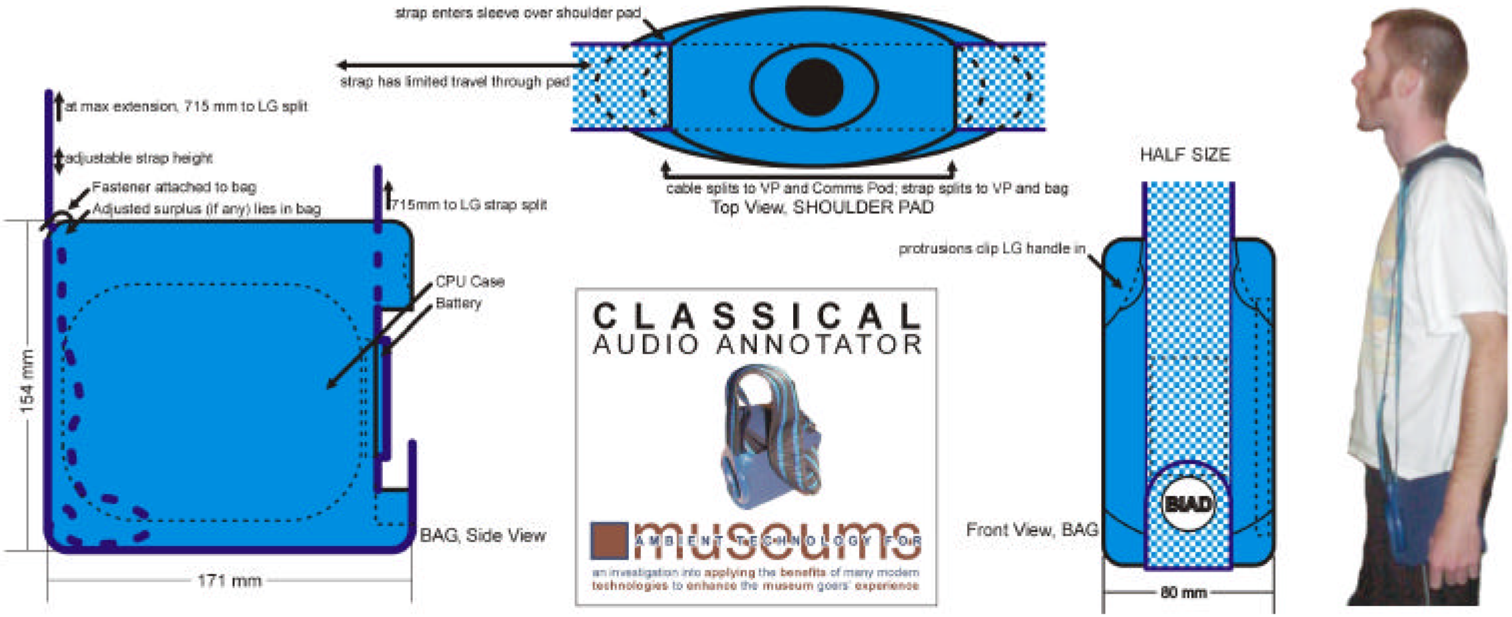
Figure 22: The bag's compartment, revealing CPU housing.

would not remain so over the necessarily large range of adjustment. This requires the shoulder pad to be relocated to the new effective centre of strap, but still be linked by cabling and ideally tend towards the centre. This is achieved through the same cabling device that joins most inkjet printer heads to the printer: a long thin plastic element laid with electrical cabling tracks folded back on itself, lying in the sleeve the strap takes through the pad.

Figure 23: The strap adjustment system. This detail is merely suggestive, a final design requires safety issues of having a n exposed hook to be considered.

Figure 25: The adjustable strap length complicates the shoulder pad, as i has to re-centre itself along the strap. This is achieved through the join with the looking glass strap being smoothed over and running through a channel in the shoulder pad (right), which has a flexible data carrying strip linking the comms pod to the strap's hidden cable.




strap enters sleeve over shoulder pad
strap has limited travel through pad
cable splits to VP and Comms Pod; strap splits to VP and bag
Top View, SHOULDER PAD
at max extension, 715 mm to LG split
adjustable strap height
Fastener attached to bag
Adjusted surplus (if any) lies in bag
715mm to LG strap split
CPU Case
Battery
154 mm
171 mm
BAG, Side View
CLASSICAL
AUDIO ANNOTATOR
museums
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HALF SIZE
protrusions clip LG handle in
Front View, BAG
BIAD
80 mm

Techno Audio Annotator

The Techno AA was developed as the ultimate solution for a strictly museum scenario and is identifiable by its extended shoulder-pad configuration.

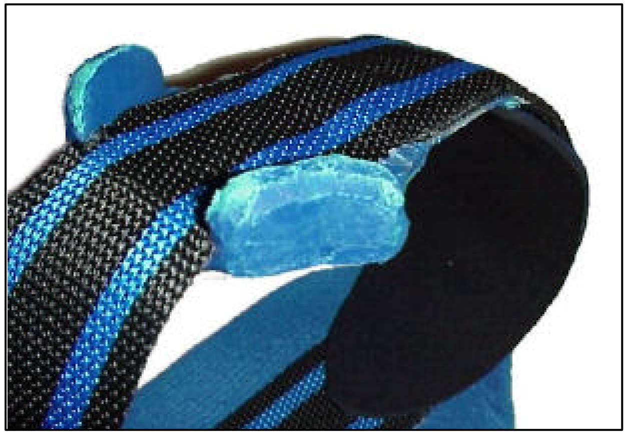
Advantages	*Disadvantages*
One size fits all No tangling looped straps Innovative form echoes innovative technology	Added material complexity Potential for being dropped

Design Issues: The concept is based around a minimal product that rests over the shoulder with no other support. This was achieved by suspension of the looking glass around the battery on the front of the shoulder and the laying of the CPU housing behind on the other side of the shoulder, thus forming a naturally stable configuration then fully secured by use of a malleable former. The issue of tangling straps – the main problem with the other models – and the issue of stowed looking glass position dropping out of reach of people measuring below the 95th percentile is solved by the extension of the looking glass strap down from the shoulder and doubling back up to effectively where it started: thus tidying away the only section of free strap and locating the looking glass on the shoulder where anatomically it is universally reachable. This picking up action also flows very naturally, correctly positioning the looking glass for instant use. The concept was initially deemed feasible as the scenario of museum use is one of bulky coats removed and only moderate body movement, and subsequent sketch modelling exploring mechanical properties and footprint eventually realised this premise. The final model uses a

Figure 26
The 'Techno' Audio Annotator. The term 'techno' is used deliberately to provoke a reaction to its non-conventional approach to technology.

lead strip laid in the shoulder-pad linking the battery and CPU housing, which has overcome all serious objections though the design is still not ideal. The malleability of the lead forming to the shoulder has proved essential over some form of sprung strip forming a clip around the shoulder, and the extent through the design is correct giving the whole product a reassuring solidity yet pleasurable flexibility on handling. The strip configuration is essential to the lead positioned over the shoulder, as it essentially gives a one-dimensional flexibility such that it can only be bent over the shoulder in the manner intended. However the strip shape becomes counter productive at the ends, where twisting is then desirable to deflect the product around the shoulder blades and breasts, as the action of the strip twisting deflects its flats opposite to the body's contours. Two wires running in channels in lieu of the strip edges would rectify this. In summary, while the shoulder-forming ability requires extra construction, and is not yet modelled perfectly, these drawbacks are outweighed by the otherwise optimum configuration.





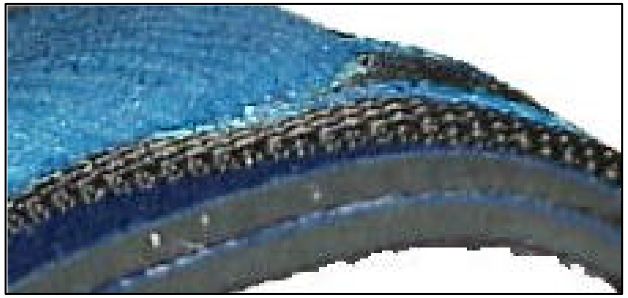
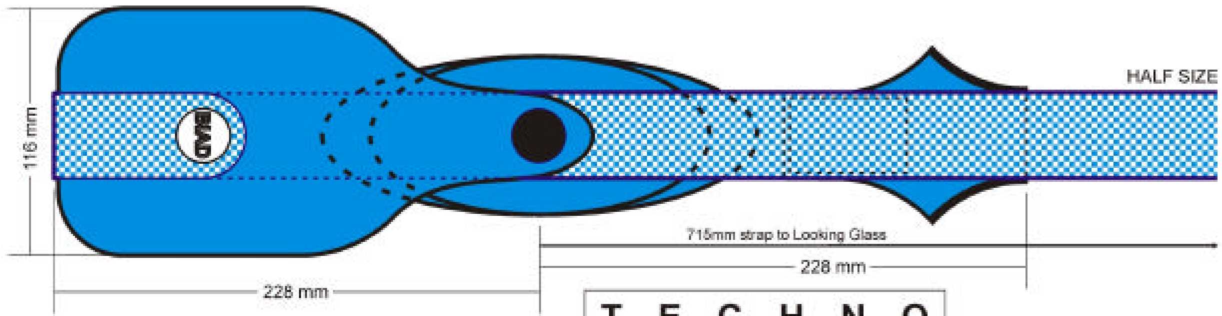


Figure 27: Right: details; Above: the malleable former strip holds the product in any shoulder/torso shape.


116 mm
HALF SIZE
715mm strap to Looking Glass
228 mm
228 mm


T E C H N O
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AA Shared Components

The designs in the AA family all share a set of common components. The looking glass and comms pod are external features, the CPU housing and battery remain unseen.

Looking Glass

The Looking Glass is a combination of the WOW display and magic wand - the mainstay of the gestural control interface. The specification was:

? Be handheld

? House WOW display

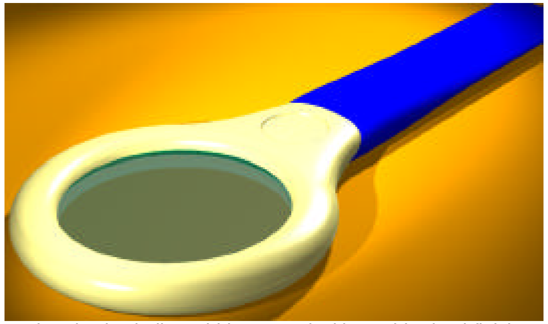
? House various sensors

? Form end of webbing continuum

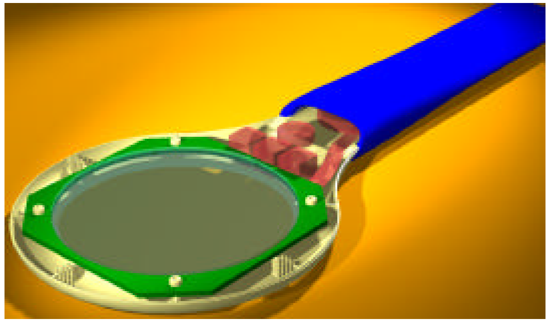
Design Issues: The defining element of this component was the WOW screen, a see-through monochrome screen through which the user looks and aligns the displayed silhouette onto the corresponding real object. As the object shape is variable, there is no functional reason to keep to rectangular convention, and a circular shape was chosen for a number of reasons:

? In framing any shape of object, a circular border gives no clue to alignment forcing the visitor to concentrate on the intended silhouette.

? Resemblance to a magnifying glass gives good semantic clues to its function, forming an elegant analogy.



The plastic shell would be coated with a rubberised finish.



The blue strap is actually a hose and opens up into a handle.

The rubber handle former traps the webbing end

Figure 28: The looking glass assembly, continued overleaf.

- ? Rejection of a rectilinear screen further distances the Annotator from (conventional) technology.
- ? As such a screen is not an off-the-shelf component, a custom design would have to be manufactured regardless.

The next issue was size of screen, which is a highly critical issue requiring novel research. The ergonomic experimentation is described elsewhere but once the dimension was deducted to be in the order of 80mm, with the strap width already set at 40mm an overall form developed very easily. The mount for the screen is a clipped square allowing a bezel of width reduced to a level proportionate with the whole form, giving outer dimension of 112mm. With this decided it was a matter of development of detail, shown through figure 28, to bring about the shared component shown here.

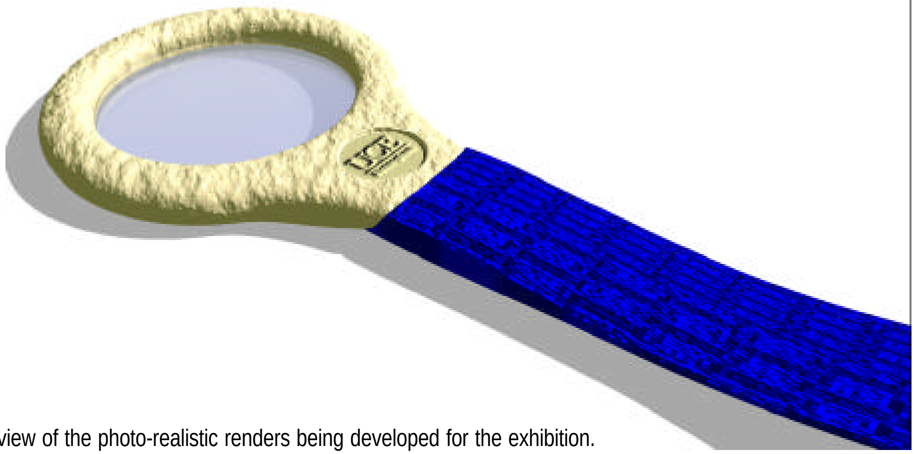
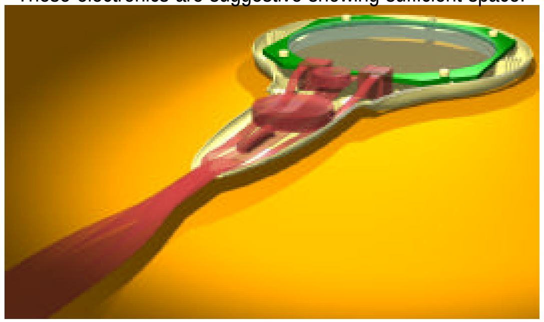


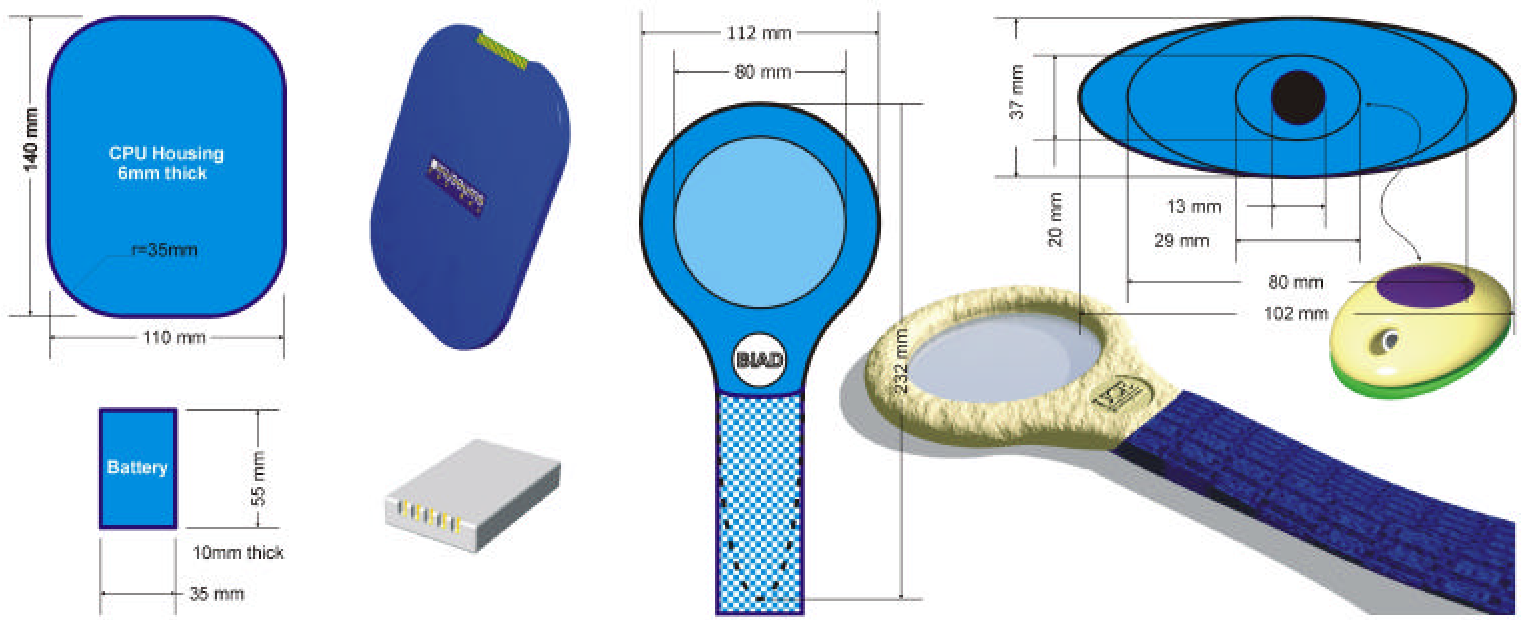
Figure 29: A preview of the photo-realistic renders being developed for the exhibition.

These electronics are suggestive showing sufficient space.



Note the ribbon cable splitting to pass through the shell end.

Note the moulding detail which locks the halves together.



140 mm
CPU Housing
6mm thick
r=35mm
110 mm
Battery
55 mm
10mm thick
35 mm
112 mm
80 mm
232 mm
BIAD
37 mm
20 mm
13 mm
29 mm
80 mm
102 mm

Comms Pod

The Comms Pod originated from the single role of housing the infra-red sensors that receive the location information, and that role has since expanded to that of in/out module. It performs the following tasks:

? Mounts the Infra-Red sensors in view of the ceiling

? Houses Infra-Red transmitter

? Provides headphone connection

? Houses female inductive charging module

Design Issues: The pod is mounted in the middle of the shoulder pad, and so had to harmonise aesthetically and mechanically with it. This lead to the obvious ovoid form, and the assembly builds around the radial fin that extends into the shoulder pad. The other concern was separatation of the data transmission zone, from the radio-interference generating charging zone, which is achieved by the sealing of the lower charging mount from the upper data mount with a sliver of foil laid between. Again detailed development is elaborated in figure 30.

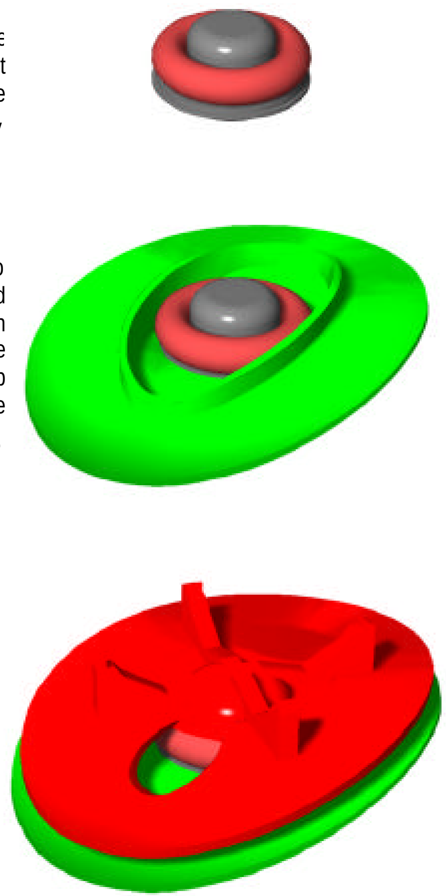
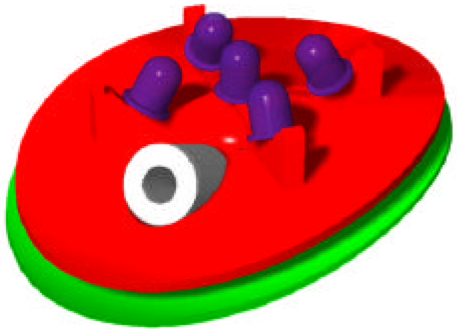


Figure 30
The comms pod assembly

CPU Housing

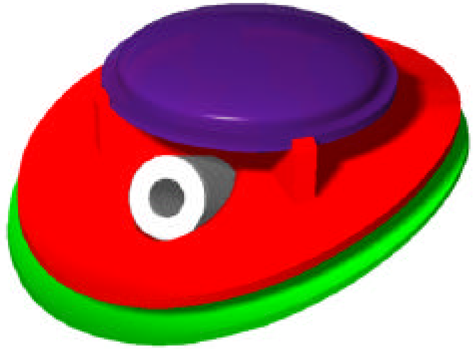
The CPU housing is a single unit in which lies all the AA's circuitry, freeing the design constraints on the periphery items to housing the end-components only. The computing power required for such a product is no more than that for an established PDA, such as Palm Pilot III, and could be much less. As this project is not dealing with electronic design, it is fair to say that the CPU housing can then be equivalent to the size of such a PDA[6], which is actually a gross overestimate as the PDA will also contain screen and battery. The size of case thus generated for this project is somewhat arbitrary, but a conservative estimate nonetheless – and with the trickle-down of technology with time this size will only shrink. The final dimensions were influenced be the decision that wider and flatter would benefit the worn nature, and derived from mirroring the width of the looking glass.



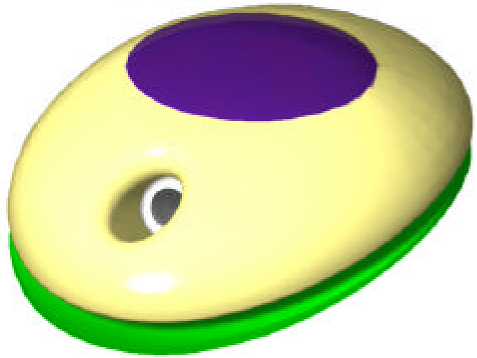
The grey tube is the 3.5mm jack headphone socket, the outer purple components are the IR sensors, the central one is the transmitter

Battery

As for the CPU housing, the battery size (and weight) is somewhat arbitrary, and is something that will only get smaller with time. To give an air of realism, I examined mobile phone batteries, which have a not dissimilar power requirement, and found a Motorola Lithium-Ion battery with dimensions that suited the idea of the webbing strap continuum.

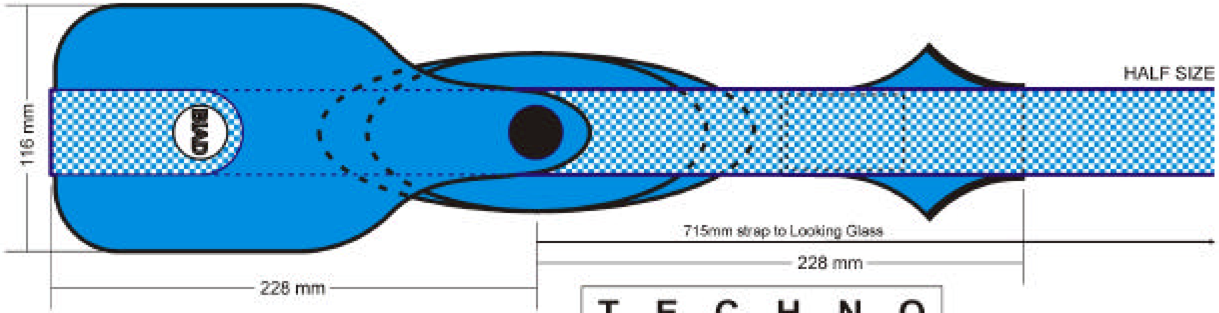


The first part of the exterior, this top section is an IR transparent lens.



The completed assembly, with shell located onto the electronics mount (red).

[6] PDAs are Personal Digital Assistants, effectively electronic filofaxes with touch-sensitive screens and no keypad.


116 mm
HALF SIZE
715mm strap to Looking Glass
228 mm
228 mm


T E C H N O
AUDIO ANNOTATOR
AMBIENT TECHNOLOGY FOR
museums
an investigation into applying the benefits of many modern technologies to enhance the museum goers' experience

Recharge Rack

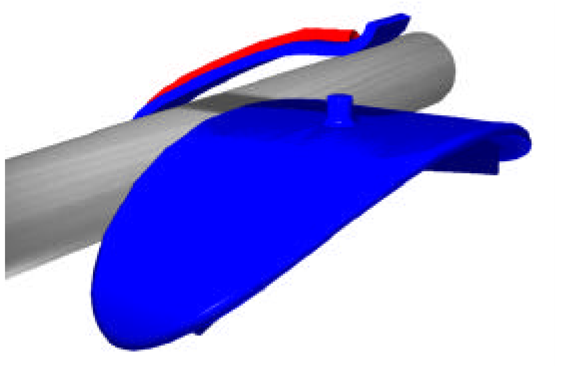
As introduced with the rest of the Museum Integration Infrastructure the Recharge Rack is where the Audio Annotators are stored between visitor use, and performs an essential role in the running of the AAs and the system's off-line informatics. The rack had the following criteria:

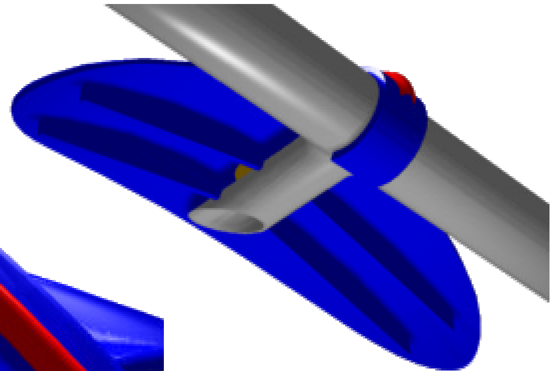
? Carry all models of AA

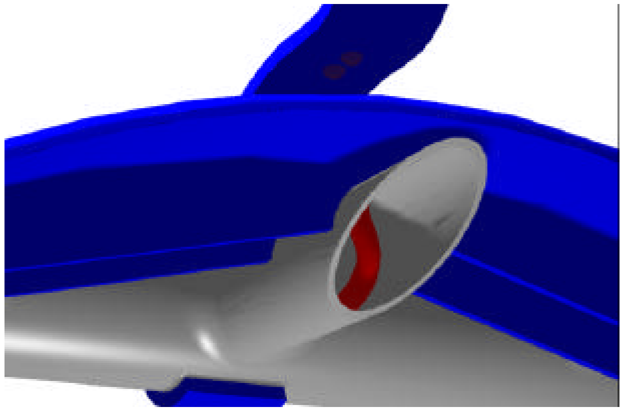
? Recharge the AAs

? Facilitate upload and download between AA and museum database

Design Issues: The main decision was to design a single unit that could be assembled in series to form a rack, thus freeing the museum to support any number of Annotators. The finger that locates the Infra-Red receiver and transmitter components above the Annotator's Comms Pod also acts as a latch to enable removal of the Annotator.







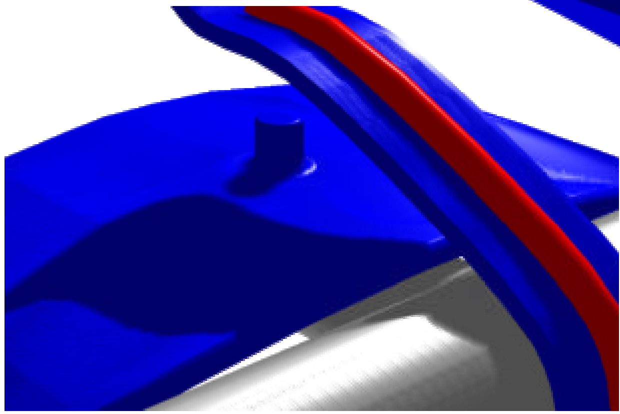


Figure 31: The recharge rack. The tubing is aluminium, the pad base with male inductive charging component is glass-reinforced-plastic and the finger mounting the IR transmitted and receiver is plastic sheet.

Public Appraisal

The conduct of this project has tended towards a private investigation shaped by world-wide research and forward thinking, such that the project was only easily comprehensible with a laboured overview or the project outcomes. As a result, the public or museum professionals have only indirectly shaped it. So with the designs finalised and models made it was time to present to these people and obtain an evaluation.

With the co-operation of Birmingham Museum and Art Gallery, a display was manned in the main foyer and museum visitors and staff were encouraged to give, or rather form, their opinion on the developed museum system. Under the banner 'Museums Through the Looking Glass: a fresh look at tomorrow's museum visit' those interested were introduced to the system and its products, and through semi-prompted discussion their views were committed to paper. Initially drawn by the A1 poster showing the project's development from research to that day, the subjects were introduced to the system through the vehicle of a museum visitor's experience – in the form of a walk-through animation – and then encouraged to physically engage with the three models of the VP family. After the discussion they were invited to quickly verify their ability to use the WOW concept, by successfully identifying a target in a field of interferers. Over the course of the day, 15 groups were involved at a depth suitable for appraisal and while by no means representative or statistically valid the 40 or so people involved gave a successful proof of concept verdict. The key points gleaned were:

Figure 32
The A1 poster used to generate interest in the project.

? The museum's management, in the form of the Head of Curatorial Services, Head Conservator and Chief Educational Officer, found no problem with the system's implementation in the museum space[7] and were positive about the interpretation benefits of the guides. Their main concern was with content management, which while effectively outside the remit of this project the system has successfully laid the central pillar to their needs by placing the content creation and maintenance firstly on an understood platform (desktop PC), secondly within the building, and lastly which updates the Annotators on the fly and with no extra cost[8].

? The museum visitors were drawn to the system, including those who were dissatisfied with existing Audio Guides.

? The WOW concept, especially if allied to the exhibit interrogation upgrade (forming the full looking glass metaphor), was seen as being of significant benefit. There were no difficulties in using the WOW mock-up rig, though first use was often somewhat confused.

? The idea of wearing headphones had a mixed reaction. Most liked the idea of not having to raise a large object to your ear to use it, but didn't want to feel cut off from the museum.

Figures 33-5 *Top: Watching the system animation*

Left: "Normal guides are fiddly, listening, walking , pressing buttons – especially fiddly, stop, play, pause etc… this is good because it will cut out complications."

Right: Apart from this novel way of wearing, note how oversized the regular model is on this perfectly valid user

---

7 This was a major concern when devising the museum system as museum environments are very precious and any invasion to this space has to be treated with great care.

8 Compare this to the present Audio Guides, which for a new narration require a non-local firm to sub-contract a recording, burn this into a microchip and ship these back, at great expense and delay.

? There was no clear favourite between the Annotator siblings. In compilation of the limited ratings obtained over the day, the Regular scored 8/10, the Techno 7/10 and Classical 5/10. People liked the simplicity and lightness of the Regular, but required the availability of a smaller size. They tended to get tangled in the long strap but didn't feel its presence when worn. The Techno despite a lower rating had the best reception, winning praise for its ability to fit anyone, from small child to adult, as well as its strap/looking glass hanger arrangement. When questioned they did not think it was too heavy, but gave a lower rating when considering their impression that the concept's promise did not live up to the concrete realisation of the simplicity of the Regular.

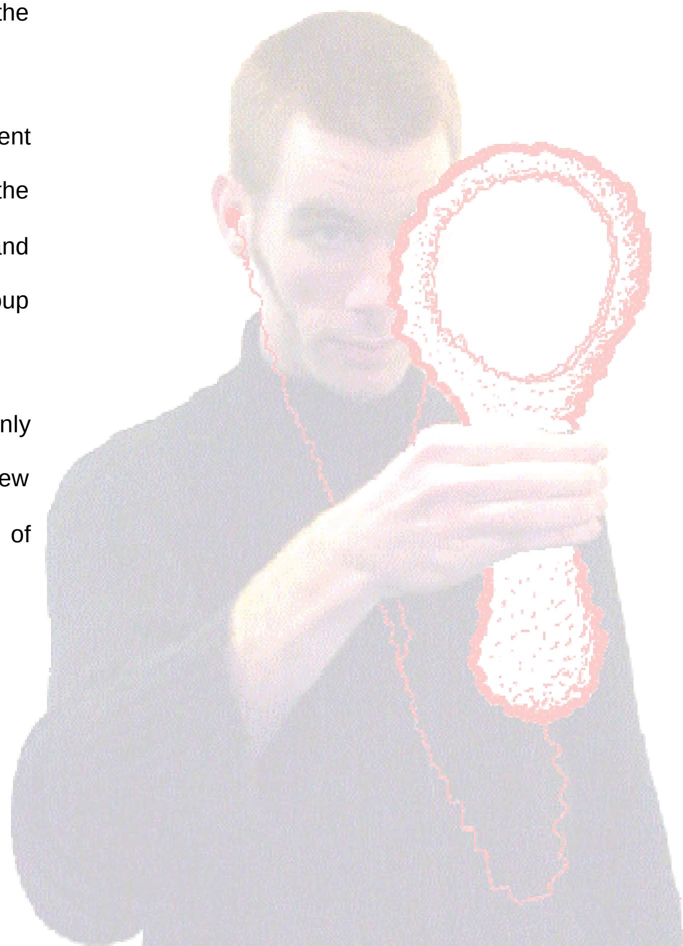
Figure 36: Susie, a history of art student, explaining the product to a Canadian lady.

Personal Appraisal

Essentially, the design outcomes and accompanying text form my conclusion to the investigation and as such I feel that they do justice to the effort put in over the eight months.

Further development of the system really requires a new level of truly detailed development beyond that achievable by a single person, besides the need for another evolution or so of the Techno Audio Annotator (which in turn requires more sophisticated fabrication facilities and materials). Advancing the system, as opposed to refining it, will involve consideration of group tools between Annotators which requires a complete reworking of the system's infrastructure.

Noting that this is not the end of the whole project, but the design stage, this leaves me only with the main investigation conclusion: in the course of designing a museum guide, a new paradigm in human-computer interaction was developed. This, I feel, shows the benefits of designing in an academic environment.



Appendix One – Research Practice Report Conclusions

The Museum System

A system proposal as research conclusion

The straight response to the brief, this proposal forms a conceptual outline of an ideal (as concluded from the exploratory research) museum system. In the consequent design practice unit the design philosophies and dissemination ideas discussed in this section – co-evoved with this conclusion - can be applied to develop the system into one suitable for real-world implementation, and hopefully one involving many quiet pleasures in use.

The system proposed is based around adding technology to the visitor, effectively providing them with a tool equivalent to a personal curator-cum-tour-guide. There are two sides to the system, this tool – the Visitors' Product (VP) – and the Museum Integration Infrastructure (MII).

The Visitors' Product has a primary function of a personal adaptive-hypermedia presentation device for enhanced understanding and enjoyment of the museum, operated by tacit and implied input synthesised with knowledge of it's position, the user, it's history of use by that user, and a virtual museum database. It has secondary functions of a navigator device and note-taker.

The Museum Integration Infrastructure supports the VPs' operation through the museum environment, accommodates off-line functions, adds follow-up material, and incorporates the VP into the greater museum visit experience.

Together, they expand the user experience beyond the museum through custom follow-up material based upon knowledge of the user's visit and provide the museum operators with invaluable museum usage information.

The Visitors' Product will feature:

? 'Looking Glass' – a novel realisation of augmented reality consisting of a transparent display used to guide user to correct registration (framing up the exhibit) and to augment exhibits with spatially aligned visual information

? Headphones – to provide aural narrative guide

? CPU & related hardware – containing database, context of use interpreter and adaptive hypermedia engine

? Sensors – hotspot determining and for gestural input

? Controls – explicit input for whatever is undesirable to be gestural

? Physical icon receptor – to provide initialising user profile

The Museum Integration Infrastructure will feature:

? Distributed autonomous transmitter tags – to mark hotspots

? Docking station – charging and information exchange

? Server computer – link to www server and virtual museum database design software

? Physical icons – different forms reflecting various broad user profiles, chosen on entry

This generic system will operate as such: A visitor will enter the museum, and be presented with a display of physical icons representing predefined user profiles, such as 'English speaking academic'. Having chosen one they will combine it with the VP they also receive. This initialises the adaptive hypermedia system in the VP to a certain degree of personalisation. The visitor then proceeds into the exhibit space whereupon an audio commentary starts through the headphones. As the visitor enters an invisible 'hotspot' around an exhibit, the narrative changes to be specific to that exhibit. Whenever the narrative makes reference to a physical feature, the looking glass is used to identify the feature and visually annotate the narrative: looking through the looking glass display effectively superimposes graphics onto the exhibit, with correct alignment by the visitor. The technologically updated looking glass itself does the majority of this by virtue of its size, and accurate alignment is achieved through a framing display consisting of a silhouette mask. The VP adapts the narrative's content and presentation as per the HyperAudio research[9], ie. through consideration of the user's responses to its presentation so far and inferences obtained by the user's movements through the exhibit space against information about the exhibits themselves. Upon leaving the exhibit space, the VP is handed back and docked onto its recharge bay where the history of the user's visit is also uploaded onto a conventional computer (and any updates to the virtual museum model downloaded). The visitor is then given the option of follow-up material customised through the knowledge of the visitor's history, which could be in the form of a web page or hardcopy. The visitor history information can logged for analysis without any legal or moral implications, as there are no personal details, just knowledge of the stereotype the visitors identified themselves as on entry.

[9] Included as appendix two

Ambient Technology

Humane design of electronic omnipresence

The term ‘ambient technology’ was conceived for this project to describe ‘the application of technology in a non-imposing and ubiquitous fashion, such that it’s benefits come readily and naturally to the user without detracting from their otherwise normal activities’. This essay will develop this premise into practical advice for designing ambient technology.

The crucial starting point is to identify how people perceive the technologies that surround them, and examine why the relationships duly built can sometimes be stressful and imposing, yet sometimes serene and even pleasurable. Various thinkers[10] have proposed that there is a dichotomy in how we perceive the world: we either have to interpret what we perceive or there is already an automatic, learnt, interpreter in place (‘affordance’, after Gibson[11], is probably the most widespread term for this interpretation). This premise can be used to develop the concept of two conscious ‘areas’ of perception: the centre where whatever we are focused on resides, and the periphery where whatever we are *attuned to without attending to explicitly* resides[12].

This notion of periphery can be used to address the two challenges proposed in the ambient technology definition: making ubiquitous technology non-imposing, dealt with next, and making the benefits of the technology come readily and naturally, dealt with after.

By designing for the periphery much information can be digested without detracting from the user’s otherwise normal activity, ie their focus, the centre. This makes the technology non-imposing, if coupled with design that allows the ability for the information source to switch easily between the periphery and centre (and back) when the information becomes relevant and needs attention. Another advantage of designing for the periphery is that it can act as a radar to the immanent future, detecting signs that something is about to happen so that when it does we are prepared for it (even if we don’t realise we are). A similar argument applies for the near past.

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[10] Computer scientist, economist, and Nobelist Herb Simon calls this phenomenon "compiling"; philosopher Michael Polanyi calls it the "tacit dimension"; psychologist TK Gibson calls it "visual invariants"; philosophers Georg Gadamer and Martin Heidegger call it "the horizon" and the "ready-to-hand" … from Weiser, *The Computer for the 21st Century*

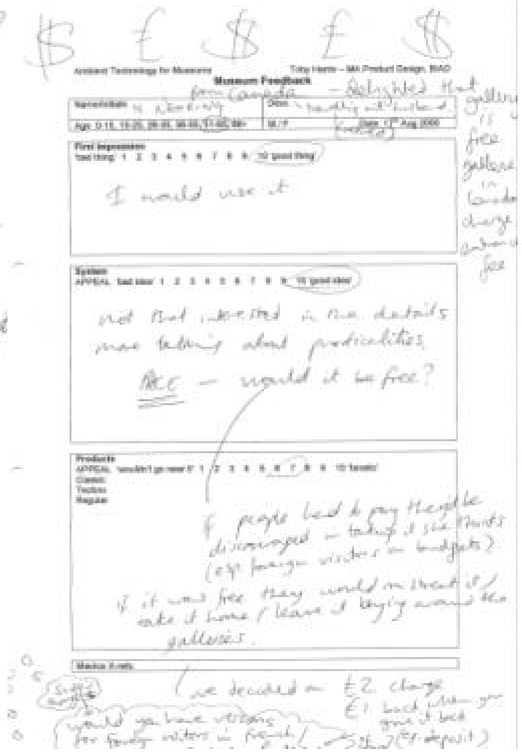
[11] Gibson, J. (1979) The Ecological Approach to Visual Perception.

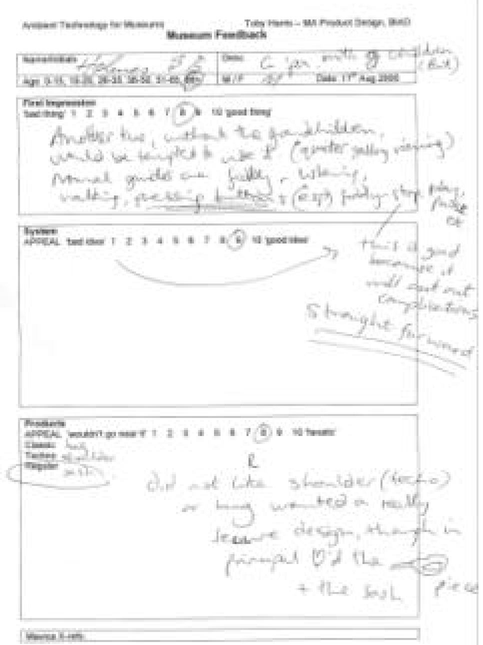
[12] Brown, J.S. and Duguid, P. Keeping It Simple: Investigating Resources in the Periphery *Solving the Software Puzzle*. Ed. T. Winograd, Stanford University.

For the benefits of ambient technology to come readily and easily it is first necessary to clarify the problem: consider that as people using technology for our own ends, the internal workings are irrelevant to the benefits. They certainly are related in the material world, but from a psychological view, or just user centred functionalism, there is no connection. Therefore, the problem of harnessing the benefits is essentially an input/output problem. The challenge then is to design the technology so it takes our wishes and delivers the results back, or more pertinently *communicates*, using human techniques. We communicate both explicitly and implicitly, then so should ambient technology. Implicit techniques will also be useful to engage the periphery, allowing a direct understanding without interpretation. Designs should therefore use speech recognition and synthesis, gestural commands… whatever people would use in the context of the technologies' use - this will be the key to harnessing the benefits of the technology naturally.

To illustrate these points with a common product of electronic omnipresence and rarely humane design, consider the mobile phone. One of the main problems of mobile phones is that of the ringer – to the user it is often quite a shock when it goes off and can often be socially undesirable. When close to loudspeakers, the signal between phone and tower often interferes and so can often be subtly heard. This can be comforting as it gives one a chance to prepare for the actual ringing almost without realising it. Likewise some phones vibrate, which the periphery is attuned to, so that when it does start there is a progression of peripheral recognition, a switch to the centre and a conscious decision to answer it or not, and if not it falls back to the periphery with ease, to the point where you suddenly realise that the caller has rung off – giving pre and post attentive perception. A recent MA project within the BIAD school of product design developed a gesturally operated mobile phone, which shows how consideration of the human angle can radically transform an established product. It mounted the phone in a scarf, turned on when picked up and adjusted to the context of its use: drawing it tight around your head assumes privacy and so reduces the volume, and so on. The challenge of this project is to develop these ideas into the conceptual stage, such that Kenneth Grange's 'small pleasures' of mechanical objects become 'quiet pleasures' of electronic products.

Appendix Two- Public Appraisal Forms





Note: These forms are the physical record of the discussions with the public and museum professionals, six are included in this report.

Ambient Technology for Museums — Toby Harris – MA Product Design, BIAD

Museum Feedback

Name/Initials: Robert Stirrel — Desc: Internet Consultant

Age: 0-15, 15-25, 26-35, 36-50, 51-65, 66+ — M / F — Date: 17th Aug 2000

First Impression
'bad thing' 1 2 3 4 5 6 7 8 9 10 'good thing'

+ve important to look at virtual + physical
how design will enable
not convinced that world is ready

System
APPEAL 'bad idea' 1 2 3 4 5 6 7 8 9 10 'good idea'

+ve product part, context, tailored, web link

feeling "is ~~anyone~~ sufficient # want to do this?"
how discreet? In ear!!

Products
APPEAL 'wouldn't go near it' 1 2 3 4 5 6 7 8 9 10 'fanatic'
Classic C
Techno T
Regular R

More reduced

Digipager

Mavica X-refs:

Ambient Technology for Museums — Toby Harris – MA Product Design, BIAD

Museum Feedback

Name/Initials: Kate — Desc:

Age: 0-15, 15-25, 26-35, 36-50, 51-65, 66+ — M / F — Date: 17th Aug 2000

First Impression
'bad thing' 1 2 3 4 5 6 7 8 9 10 'good thing'

Good idea
all for it like learning

System
APPEAL 'bad idea' 1 2 3 4 5 6 7 8 9 10 'good idea'

clarifies
whole picture

was quite alien but
know where coming from
with expl.

Products
APPEAL 'wouldn't go near it' 1 2 3 4 5 6 7 8 9 10 'fanatic'
Classic C
Techno T
Regular R

Techno... looks?... oh no its higher

Mavica X-refs:

Ambient Technology for Museums — Toby Harris – MA Product Design, BIAD

Museum Feedback

Name/Initials: (Ed) Payer — Desc:

Age: 0-15, 15-25, 26-35, 36-50, 51-65, 66+ — M / F — Date: 17th Aug 2000

First Impression
'bad thing' 1 2 3 4 5 6 7 8 9 10 'good thing'

Excellent – you don't really know what you're looking at unless you're something – its fun

System
APPEAL 'bad idea' 1 2 3 4 5 6 7 8 9 10 'good idea'

wow fabulous.

Products
APPEAL 'wouldn't go near it' 1 2 3 4 5 6 7 8 9 10 'fanatic'
Classic C
Techno T
Regular R

Techno: perfect, like that one
like bag least – confused with own handbag

Mavica X-refs:

Acknowledgements

Jack Ingram – This project and its outcomes are indebted to his insightful supervision and more ephemerally to his shaping of the MA working environment.

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Roderick Davies – For museological debate.

Jenny Thatcher – For proof reading this report.

Susie Forbes – For assisting with the Public Appraisal.

Key WWW Gateways

Ambient Technology for Museums	The on-line presence of this project.	http://www.tobyzstuff.co.uk/maproject
HyperAudio	The homepage linking to all research papers developed for this significant technology used in this project	http://ecate.itc.it:1024/projects/hyperaudio
BIAD Museums Project	A central resource for museum related projects conducted, like this, at BIAD.	http://www.biad.uce.ac.uk/research/museums

Note: All online sources available August 2000