HeritageVista: Informative, Personalised and Engaging Visitor Experiences

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Abstract
We are developing an infrastructure to support and evaluate using blended spaces with a semantic network to provide on-line and *in situ* informative, personalized and engaging visitor experiences at National Trust sites.

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Blended theory, information space, semantics, physical space, virtual space

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
We are developing a novel infrastructure to support on and off site visitor experiences at National Trust (NT) properties. The NT is a major conservation charity in the UK that protects historic buildings and landscapes of national interest while providing visitor access. At present none of their sites has any off-site "experience" and few provide anything more than a simple on-site audio tour. There is scope to use mobile and fixed interactive systems to provide rich, engaging experiences, however, a robust infrastructure will be

needed to support personalised information delivery (see Table 1). We propose to develop such an infrastructure to support two aims:

1. The provision of customised content based on a user's personal interests and preferences.
2. Linking three "spaces" in which a user can have an experience of an NT site: Physical, Information and Virtual.

Related Work

There has been much research on how to navigate these three different spaces (physical, information and virtual) when each is considered in isolation. This research includes investigations of way-finding [1], hypertext navigation [2], presence in virtual reality [3], the nature of landmarks [4], how we understand where we are and how this relates to where we are going [3]. However, there is relatively little work on experiences composed of the three spaces interlaced together. Work on blended spaces [5][6] provides a foundation that may be used to guide the construction and understand the implications of such experiences. In developing an infrastructure that supports on and off-site experiences for the National Trust, we propose to enable and support user experiences created through the traversal of these spaces, individually and together.

Customisation

The information that is to be presented about the property will be encapsulated in a semantic network. A user may traverse this network either by explicitly selecting her next point of interest (relevant to her current position in whichever space she is currently active) or having a next point of interest selected automatically as part of a narrative derived from her known preferences. At each point of interest, the user will have the opportunity to rate the relevance of the information. This rating will feed back into her preferences, increasing the reliability of future node selections based on the user's interests [7].

Each piece of information that could be presented is associated with a node in the semantic network. The links between pairs of nodes will be composed of a number of different "threads". Each of these will represent a different type of semantic relationship. Some of these threads will be ontological such as "part of" or "contains" and will allow exploration of a topic in more or less detail, while others will express relationships that are topical, temporal, spatial or provided based on a curator's knowledge. Associated with each thread is a cost calculated from the separation (in terms of its semantic relationship) between the nodes at either end. For example, spatial threads have a lower cost based on the physical separation of their nodes while curatorial threads have a lower cost when connecting nodes that a curator wishes to present consecutively.

A single pair of nodes can be connected by many different threads but these will always aggregate into a single link. This link has no pre-computed cost as this needs to be computed dynamically based on a "guiding function" that encapsulates the various preferences and constraints of the user. The application of this guiding function merges the individual thread costs together into a single link cost. From amongst all the candidate next nodes, the node at the end of the link with the lowest cost will be the one presented to the user next if the user is being guided automatically. Each time a node is selected, the guiding function can be tweaked

to re-align it with the user preferences, making future automatic recommendations better.

The guiding function embeds two types of preferences: explicit and implicit. Explicit preferences are those learned from the user's preferences or by direct selection from the user and include topics the user is interested in, such as whether they want a tour that is "curated" for them and whether they have accessibility issues that constrain where they can go and what they can look at. Implicit preferences are those over which the user has no choice and include constraints enforced by the physical layout of the site or restrictions imposed by the National Trust. The guiding function is continuously modified through the application of external constraints, including whether the content is being viewed on or off-site as the constraints on each would be different (Figure 1).

The information associated with each node has to be comprehensible on its own. However, associated nodes can deepen the user's appreciation of such content. The content for each node shall contain multiple representations of the same entity. For example, a node representing a painting might include an image of the painting, a textual description of it, and an audio recording of the artist describing the painting. Any subset of these representations can be presented to the user depending on their preferences, the medium of interpretation and their physical requirements.

The sequence of nodes traversed in an experience will form the trajectory [8] of that visit.

Spaces

The nature of the experience is defined in part by where it takes place. The experience exists in three different places or spaces: physical, information and virtual space. Each of these three spaces has advantages and disadvantages in terms of user experience and what genre of content each space excels at presenting. By playing to the strengths of each space, and transitioning between them when necessary or when the user desires, it should be possible to create a rich and engaging experience [5].

Physical Space

The physical space is the heritage site itself and is the space currently experienced by visitors to NT properties. The physical space is tangible and tactile and presents both architecture and content to the user in the richest possible detail. However there are also examples where historic buildings or artefacts are no longer in existence or have been separated from their original context, and presenting them effectively in the physical space is challenging.

The Information Space

The information space is the semantic network of information described above. Information can be both bound to a particular place or object within the physical space or be contextual information that can give a fuller understanding of the site but doesn't "belong" to it. The contextual information will be bound to the site information using the semantic links outlined above.

The Virtual Space

The virtual space is a space of information and interpretations that cannot be realised in the physical, such as digital reconstructions of ruined buildings. It

will provide an immersive experience of objects or places that either no longer exist or do not exist where the user currently is. The virtual space will also be the primary contributor to the experience when the user is off-site, for example experiencing an NT property through a computer at home.

Binding the Spaces

To provide a rich user experience the spaces need to be linked such that the user can move between them and traverse within them. The aim is not to provide a seamless experience which will always be difficult, but to ensure that the user understands what is available, how to navigate within a space and how to transition between spaces such that they get an experience that is suited to them [6].

Although each space will be accessible independently, there will also be transition or anchor points in each space that can be used to access experiences in alternative spaces. In the physical space anchor points are items of interest to the visitor, while in the information space anchor points are those nodes that represent items that exist in the virtual space, the physical space or both. In the virtual space anchor points are spaces or items that exist in the information space. Transitions between the physical and virtual spaces will be mediated by passing through the information space (see Figure 2).

To enable this mediation, a 3D representation of the physical space will be held by the information space such that the information space can use geo-location (e.g. computer vision, GPS, indoor positioning) [9] techniques to identify where the user is and what she is interested in, such that she can see the information nodes associated with her position and can enter the information space when she wishes to. To allow the transition back to physical space, AI navigation techniques [10] will be employed to direct the user to the physical space that corresponds to the node in the information network at which she has arrived.

Figures

Visitor	Contents	Context	Example
P	P	P	Current NT Experience
P	P	V	Augmented Reality – existing content in a virtual context.
P	V	P	Augmented reality – placing missing content in existing context.
P	V	V	On-site VR Experience
V	P	P	Web camera view of a site.
V	P	V	Augmented Virtuality –content from webcam in virtual off-site context.
V	V	P	Augmented Virtuality – virtual content from webcam context off-site.
V	V	V	Off-site VR Experience

Table 1: Experience Matrix. (P = Exists Physically, V = Exists Virtually) The matrix illustrates a range of experiences that are possible on National Trust sites when an integrated experience is supported.

Figure 1: To select automatically a "next node" when at a "current node", the properties of the link between the "current node" and all its adjacent nodes (e.g. Theme, Temporal etc.) are passed through a blending function that weighs each of these properties against the user's preferences and produces a single blended cost. The "next node" with the lowest blended cost shall be the node automatically selected as being the most relevant to the user's interests and constraints.

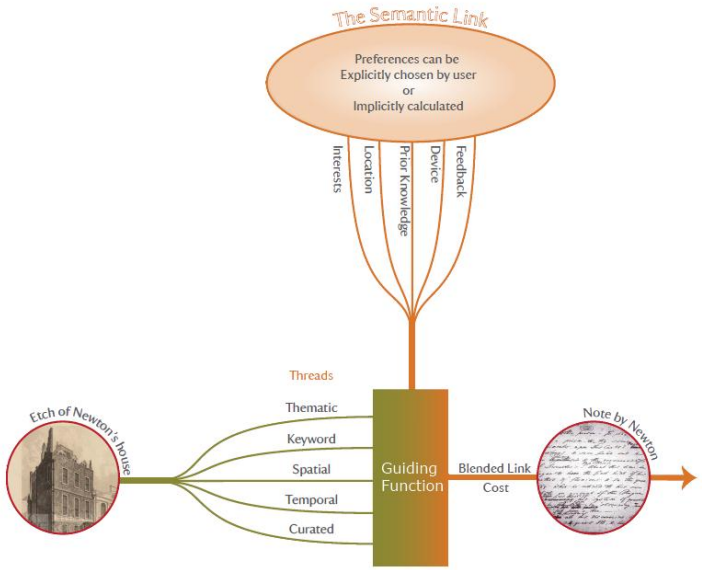
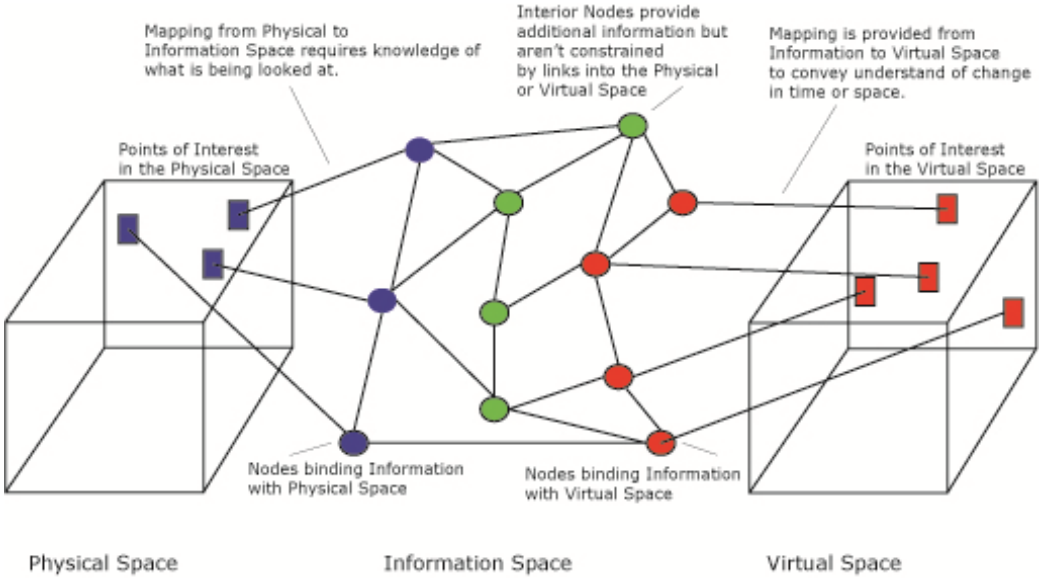


Figure 2: The physical, virtual and information spaces are linked through content that exists in the other spaces.



Conclusion

Our ongoing work seeks to develop a novel infrastructure that is capable of delivering rich content, both directly related to a given NT site but also content with a wider contextual relevance, together with VR representations to provide visitors with an engaging experience both on-site and off-site. This infrastructure will draw on prior work on semantic networks, information space, virtual reality and blended spaces. Through investigating the resulting experiences, we aim to understand the implications for user engagement, enjoyment and education and to enhance the National Trust visitor experience.

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