Adaptive Hypermedia in Augmented Reality

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ABSTRACT

Applying Adaptive Hypermedia techniques to Augmented Reality museum tour guide applications promises great advances in presenting material on museum exhibits. Information selection and presentation can be adapted according to the visitor's goals, preferences, knowledge, and interests and this information can be overlaid over the real object and its features.

Existing mobile AR tour guides tend to present information using hand held devices or display hard coded, predefined labels over the object's features. This paper describes initial work on a system that can provide dynamic, adaptable information overlaid on objects.

KEYWORDS: Adaptive Hypermedia, Augmented Reality

Introduction

The use of Augmented Reality (AR) in museums promises great advances in natural interaction with museum artifacts and their data. AR systems combine real world scenes and virtual scenes, augmenting the real world with additional information. This can be achieved by using tracked see-through head mounted displays (HMD) and earphones. Rather than looking at a desktop or hand-held screen, visual information is overlaid on objects in the real world.

As museum visitors wear their own private HMDs, information being presented about a museum artefact can be adapted personally to each individual. This information could be about specific details of an object or the system could point out features of interest that they might have not noticed. Related objects could be projected next to the artifact for comparison. Different views could be presented, such as an x-ray view or a reconstruction of how the artefact originally looked.

Existing AR museum tour guides do not provide enough information on specific artefact details. Merging the real object with augmented information clearly presents the relationship between the data and the object. We propose a technique that dynamically adds adaptive labels to artefacts' 3D models that suits the user's needs.

Annotating Museum Artefacts

AR environments augment the real world with information or virtual imagery; virtual objects are usually stored as highly texture-mapped 3D models to appear realistic. An approach to presenting information about an artefact's features is to annotate it with dynamic labels, resulting in a 3D version of a labelled diagram.

Labels must be generated dynamically, depending on the visitor's preferences or the system's state. The user information is obtained from the user model, which could contain features such as their goals, preferences, knowledge, interests, previous interactions with the system and so on.

Taking an open hypermedia approach to the problem, all object information is referenced from or kept in a linkbase; it is separate from the artefacts' 3D models. This raises the issue of how to dynamically attach this information to the relevant features.

System Overview

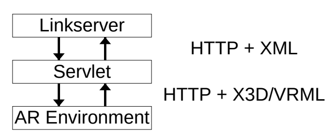

Figure 1: System Architecture

There are three main components in the system: the AR environment, a Java Servlet and a linkserver.

The AR environment loads an artefact model by requesting the model's ID through a Java servlet on a webserver. This servlet performs various tasks, such as querying the linkbase for information and placing description labels around the artefact object. The servlet will start by retrieving the artefact metadata and the model's location, which are both stored in the linkbase.

The servlet then loads the artefact model, which is stored as an X3D file; X3D is a next generation, extensible 3D graphics specification based on XML and is being developed by the Web3D Consortium [1] and the World Wide Web Consortium [2]. The model is split into its various components, and each component is given a name or unique identifier. When the servlet loads the model, it looks for components with valid identifiers and uses these to query the linkserver.

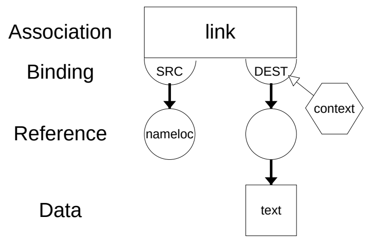

Figure 2: FOHM structure for a feature description

The linkserver looks for any relevant description and returns these to the servlet. The system uses the Auld Leaky linkserver, a context based link server implemented around the Fundamental Open Hypermedia Model (FOHM) [3]. In the FOHM linkbase implemented, an artefact's feature description is represented by an *Association* object. Associations have a source *Binding* object, containing a *Nameloc* object, and several destination bindings. Namelocs identify selections within any object or file by name, making Namelocs generic as a named feature can occur in various different objects. Each destination binding contains or links to a description for the feature and is bound to a *Context* object. The context object defines the description type and is used by Auld Leaky to distinguish between which bindings should be returned. This is shown in Figure 2.

When the linkserver receives a query, it returns an appropriate description. Similar objects will receive the same descriptions if they both have identically named features; this is useful as generic descriptions can be applied to objects without having to implicitly author descriptions for each object. New artefacts can be added to the system and be labelled without any material having been specifically written about them.

However, there will be cases when specific descriptions are needed. These can be resolved by adding FOHM context objects to bindings containing such descriptions. When the linkserver receives a query, the query will be bound to a context that is used to filter out any irrelevant descriptions.

An artefact's context is defined by it's metadata, which is stored as a *Data* object in the linkbase. This metadata can include various pieces of information, depending on the artefact; examples could include the name, type of object, reference number and so on.

The user model can be used to create context objects to tailor descriptions to the user's preferences. For example, each description binding can have a context stating the type of user: children or adults. When the query is made, only descriptions suitable for either ones (or both) will be returned. An example of this is shown in Figure 3. The label on the left is adapted for children, while the label on the right is adapted to adults.

When the servlet receives a description, it places it in a label next to the relevant feature. Labels are placed in a way so that they do not collide with each other or the artefact model.

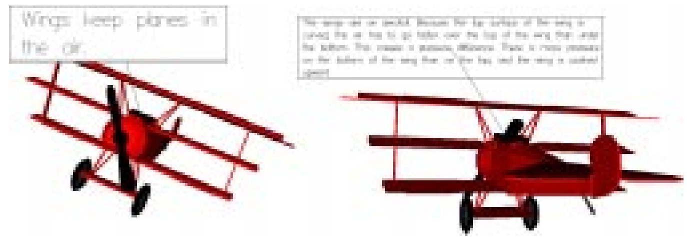

Figure 3: Adaptive labelling

Conclusions

The technique presented provides dynamic, adaptive labelling of artefacts that can be used in existing AR systems. New models can be added to the system and be annotated with existing descriptions. Different sets of descriptions can be applied by adding additional linkbases. As artefact information is kept separate from the artefact models, it is easier to author and maintain; descriptions can be changed in a link editor without loading a 3D model. Non-authored or generic links provide more information that is normally manually authored or maintained. The use of context is important in order to customise the information for the individual as well as prevent information overload. The simple example illustrated in Figure 3 shows how it can be used to create descriptions for different types of users. Future work will look at more complex ways of generating adaptive descriptions. Research done at Southampton on context and user modelling [4] could also be applied to the Auld Leaky linkserver to produce more dynamic and adaptive material.

More work will be done on the navigational hypertext aspect of the system so that link following causes a new model to be loaded. Labels need to be extended to use other types of media, such as images, video, audio and other 3D models.

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