Virtual Heritage To Go

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Motivation
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- 3D interactive content important building block for Virtual Heritage applications
  - Exploration, analysis, presentation, documentation, and reconstruction can be assisted with 3D content
  - Communication can be eased by avoiding inefficient media or the need for traveling to historical sites
  - Attention of museum visitors can be caught with modern technologies
- Mobility becomes more and more important
  - Most people have smartphones or tablets
    - Most systems require different apps
    - The need for installation etc. is a barrier
  - Mobility is essential on site
- With various devices synchronization is an issue
  - Would be nice to avoid this at all → Distributed application model
Motivation – Use Cases

- Virtual museum
  - iPads etc. can catch the attention of visitors
  - Objects can be virtually placed in the correct context (augmentation in original room)
  - Mobile devices to assist or replace guides

- On site
  - Visitors can display virtual models of a ruin area (→ combination with AR possible)
  - Mobile device as replacement for a guide

- Restoration and communication
  - Many people included during curation and reconstruction of a historical object
    → better communication ways required
  - Annotations help to preserve and propagate information through various stages


Requirements
Technical Requirements

- 3D presentation in a Web Browser with integrated use of Web technology
- One single app for desktop machines and lightweight mobile devices
- Integration of 3D content into DOM tree for easing scene manipulation
- No need to install programs, plugins or special applications
- Performance and interactivity
Functional Requirements

- Intuitive interaction / navigation
- Presentation of metadata in well arranged way and possibility to show corresponding (annotation) marker on the model
- Possibility to create and display annotations and corresponding marker
- Desirable to create, modify and share 3D content similar to other media
- Availability of different search filters, etc.
Technical Approach
Technologies – 3D Content

- **X3DOM**

  - Enables declarative 3D content inside a Web Browser with enabled WebGL or Flash 11/ Stage 3D
  - Fallback to Flash if WebGL is not available/enabled
  - Builds upon open standards → good integration with HTML5, CSS3, DOM Scripting and Ajax
  - Uses the X3D XML format with some modifications for HTML integration (e.g. for event handling)

http://www.x3dom.org/
Technologies – Mobile JavaScript Frameworks

**JQuery/ JQuery Mobile (our recommendation)**
- Very powerful
- Easy to use
  - Easy theming
- Well documented with many examples

**JQTouch**
- Very lightweight and performant
- Bad documentation
- Very nice look and feel
- Optimized for WebKit – bad support for other Browsers

**Other Frameworks are available**
- All aim at providing look & feel of native apps
To present 3D content on mobile devices without installing an app, we need a WebGL compatible Browser

Apple’s WebKit implementation on iOS (iPhone, iPad) supports WebGL, but it is not enabled in Safari

In future this will (hopefully) change

- Till then one can work around this by writing a little Browser wrapper around the UIWebView widget that just enables WebGL
- Use of instantGLory – WebKit-based Browser that supports WebGL

```swift
UIWebView *webView = self._webView;

id webDocumentView = [webView performSelector:@selector(_browserView)];
id backingWebView = [webDocumentView performSelector:@selector(webView)];

[backingWebView _setWebGLEnabled:YES];
```
Technologies – Ready for Implementation

- We now have a…
  - JS framework to support the look and feel of native apps
  - Web Browser that supports X3DOM
- All further development is 100% the same for mobile devices and the webpage based approach
Implementation
Implementation – Loading Objects

- To browse to different objects, a list can be used containing hyperlinks
  - Each `<a id="pre_objectID">` tag can contain an ID that is equal to the directory of the folder containing the object data.
  - Or the ID can be the key for a dictionary-like data structure that contains the paths to the objects.
- The `<Inline>` tag is used to load an X3D model
  - JavaScript can be used to dynamically switch the URL and load an object:
    - `document.getElementById("inlineID").setAttribute("url", "path/objectID/model.x3d");`
- When the link is clicked, a function is executed via the `onclick` event to switch the model as explained.

![Example Image with Objects]
Implementation – Data Container

- All data corresponding with an object supplied via
  - JSON
  - XML
  - Database such as MySQL or CouchDB

- The data can hold
  - Traditional content such as images and the text that shall be displayed for metadata
  - 3D information (e.g. for annotation markers or suitable camera positions)
  - Application logic
  - …

```json
{
  "title": "xxx",
  "model": "xxx",
  "URL": "folder/name.x3d",
  ...
  "meta": {
    "ID": "test_1",
    "Name": "xxx",
    "description": "xxx",
    ...
  },
  "annotation": [
    {
      "pos": "48.0 55.5 6.5",
      "text": "Looks like a snake",
      "link": ".wikipedia.org"
      ...
    },
    ...
  ]
}
```
Implementation – Metadata

<display_date/>
<temporal_coverage>
<creation_date Recommended="September 2011"/>
</Collection>
</Subject>
- <Record_Information>
  <ID Mandatory=""/>
  <source/>
  <creator>Nicola Amico</creator>
  <creation_date Recommended="26/03/2012"/>
  <country Recommended="Cyprus"/>
  <language Recommended="English (EN)"/>
  <rights>STARC - The Cyprus Institute, Department of Antiquities of Cyprus, Archaeological Museum of Nicosia</rights>
</Record_Information>
- <Appellation>
  <Name Mandatory="Cruciform figurine"/>
  <ID Mandatory="1963-XI-22-9"/>
</Appellation>
- <Description Mandatory="This anointing flask is made of molded blue glass and depicts a human face. Mold-blown glass vessels appear in the first half of the 1st century A.D. The molds were probably made of clay into which the vessel's details were carved."/>
- <temporal_coverage Recommended="Roman period (50 B.C. – 150 A.D.)">
  <time_span>
    <start_Date Recommended=""/>
    <end_Date Recommended=""/>
  </time_span>
  <period_name Recommended="Roman period (50 B.C. – 150 A.D.)"/>
  <display_date/>
</temporal_coverage>
<Type Recommended="Archaeological Object"/>
- <Measurement>
  <perimeter>
    <type/>
    <value/>
    <unit/>
  </perimeter>
  <area/>
</Measurement>

ID
1963-XI-22-9

Name
Cruciform figurine

description
This anointing flask is made of molded blue glass and depicts a human face. Mold-blown glass vessels appear in the first half of the 1st century A.D. The molds were probably made of clay into which the vessel's details were carved.

Source
Archaeological Museum of Nicosia

Site
Korakou

height
0.087 m
Metadata can be displayed in lists and filtered by typing text into a search field while hiding wrong results via jQuery/ CSS3.

Since X3DOM integrates the model into HTML5 it is possible to merge the 3D content with textual and other information.

By default we just display the headings of each metadata.

- By tapping on them they expand.

There exist various display modes, e.g. full 3D area or all information extended.
Implementation – Annotations

- If many people work together on one model, annotations are a good way for communication
  - They pass information from one person to another
  - They can be attached to a certain position in the model (➔ green marker)
  - They can hold all kinds of information such as the author, creation date, text, hyperlinks, images, etc.
  - They can be stored permanently
- For loading, all mentioned data container formats (JSON, XML, …) are possible
- For persistent storing it is necessary to use a database, since JavaScript does not allow writing to disc
Implementation – Create Annotations

- First the user has to activate the annotation creation mode by tapping on the [new Annotation] button.

- When tapping on the object, the position can be saved via:

  ```javascript
  function createAnnotation(event) {
    newAnnot.posX = event.worldX;
    newAnnot.posY = event.worldY;
    newAnnot.posZ = event.worldZ;
    ...
  }
  ```

  (don’t forget to register the event listener)

- The [done] button saves the data in the form permanently in a database.

  - A marker can be generated by first creating an empty `<Group>` with an ID.

  - Then attach a geo to it, set the saved position and register event to show the annotation popup.
Implementation – Multi-touch Navigation

- Swipe
- Zoom
- Rotate
Implementation – Multi-touch Events

1. Check if navigation or interaction is needed

2. Set flags for transition between navigation (per scene) and interaction (per object)

3. Identify individual touch points; check state transitions: press (0 → n), move (n → m), release (m → 0)
Results
Performance

- Used mobile devices: iPad2/ iPad3
- It takes about 0.5 seconds to load a model with the following specifications from an external server:
  - Original Model Data
    - Vertices: 714,916
    - Triangles: 1,428,982
    - File size: 28.6 MB
  - After Optimization with Quadric Edge Collapse (in MeshLab)
    - Vertices: 100,305
    - Triangles: 200,000
    - File size: 8.06 MB
  - After optimization with binary compress. (cp. BinaryGeo paper, Session 1)
    - File size: 4.02 MB
- No visual difference between original and compressed model on iPad
- Leads to a significant decrease of loading time, reduces memory & CPU overhead
Generality

- Concept also works for other domains such as automotive industry (CAD viewer).
- Prototypes show that it is possible to replace applications like jtToGo and run them online with no need for local installations etc.
Conclusions

- Works in modern Web Browsers without plugins
  - Look and feel is comparable to native apps
  - Device independent
- One solution works on all kinds of devices
  - Saves development time, money and allows Web developers to directly start coding 😊
- All technologies are based upon open standards
  - Expectable that app remains accessible in future
- Very interactive and nice merging of 3D models with traditional media contents
- Smooth 3D interaction and short loading time
- Huge potential for annotations and communication
  - Distributed application model
Results

V-Must
3d Browsing
Thank you!

Questions?

examples.x3dom.org/v-must/
user/passwd: vmust/vm2012

www.x3dom.org
www.v-must.net