Multi-channel Coverage for a Dangerous Australians Museum Exhibit

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Abstract. Dangerous animals fascinate people; and Australia has more than its fair share of them. This paper outlines our work in the design of two different museum applications that are able to reuse a single-source of content to cater for the specific needs of their target audience. The underlying goal of this work is to show how museum content can be made more accessible, more interactive, and personalised to different users and their situational context. This is achieved through the use of modern computing platforms like mobile phones and interactive wall displays that support ubiquitous, context-sensitive, and personalised information delivery.

Keywords: Multi-channel content delivery; personalisation; user-centred design.

1 Introduction

Museums are trustees to some of our most valuable content. Museums are also tasked with the role of making such content available to the community at large, and in the appropriate format for consumption by people with different interests. Modern technologies help to support this goal, but it can be an arduous task to design content specifically for each of these technologies. Furthermore, each person is unique, and this gives rise to the need to personalise content to the explicit needs of the individual, be that for example, their age group (e.g. children and adults), the situational context (e.g. consider tourists and school classrooms), and the underlying device form factor (e.g. phones and wall displays).

In this paper, we describe two applications that have been built to make a museum's exhibit on dangerous Australian animals accessible outside the physical bounds of the museum. In addition to catering for two widely differing user groups and situational contexts - i.e. children in schools, and the general public/tourists - these applications also leverage the interactive and personalised nature of the individual platforms on which the content is shown. The first application runs on an interactive whiteboard and has been designed to cater specifically for the growing number of schools with interactive whiteboard technology. The second application has been designed for mobile phones, and it targets a more general audience including both those people local to the country,

and visitors from afar. Both of these applications access the same content, but their manner in presenting content and the ways they cater to different target user groups differs; this is largely also due to the unique nature of the platforms for which they have been developed for.

2 Related Work

The goal of adapting information to make it applicable to different audiences has long been the task of museums. Two notable museum guide projects are that of PEACH [11] and CHIP [10], which aimed to bring contextualised and personalised information to users as they toured the museum. In comparison to past museum work, which often focuses on dedicated single-purpose museum implementations, our work forms a backdrop in which we hope to learn how to personalise the user experience across multiple device form factors.

A focus of our work is also on the reuse and repurposing of content across devices of different form factors. Some notable past work in this field includes [2] and [1], in which the problem of displaying web pages for multiple heterogeneous devices is outlined and in which repurposing strategies for web page content are defined; such strategies typically revolve around the separation of content from page templates and style sheets. Whereas past work into content reuse and repurposing tended to focus on web-based solutions and a single family of devices such as mobile phones (for which there can still be thousands of different device variants), our work instead aims to look at content reuse across substantially different device form factors (e.g. small mobile and large surface computing) and, in the future, across different interaction paradigms (e.g. single- and multiple-user interaction).

3 Dangerous Australian Animals

A goal of this work is to explore, together with our museum partner[1], the manner in which museum content can be made accessible to a larger number of people. The museum has an extensive collection of physical exhibits on dangerous[2] Australian animals. It also has detailed information on such animals available via its website. While the physical exhibits allow museum visitors to interact with the collection in a number of ways, such as by walking around the specimens, and sliding out collection drawers to see some of the smaller animal specimens, the website provides detailed information on aspects like their appearance, distribution, and information on the treatment of bites and stings from such animals.

The platforms chosen for the implementation of our two applications were that of smartphones and interactive whiteboard displays. Mobile devices, and particularly smartphones, have experienced exponential growth over the past several years. They also offer particular promise for personalised applications

[1] The Australian Museum, URL: http://www.australianmuseum.net.au.
[2] See [7] for an explanation on how the term "dangerous" is rated within this context.

because they are always on and typically always with the user; their touch-screens, and incorporation of numerous I/O channels (including sensors), also provide the foundation for highly engaging interaction. Interactive whiteboards and surface computing, on the other hand, represents an area that is still in limited deployment. Already, and aided by government initiatives, most schools in Australia have interactive whiteboards. Like smartphones, such whiteboards provide for highly interactive touch-based user experiences and while these boards lack personalised single-user interaction, they have the ability to support group collaboration.

3.1 Dangerous Australians as an Interactive Whiteboard Application

Consider a rural school that is far away from the city's museums. The teacher would like to show the students one of the museum's exhibits, but the travelling distance makes this unviable. The students are keen to learn about dangerous Australian animals, and particularly those that are present in their locale.

Our Dangerous Australians interactive whiteboard application (Figure 1) uses textual, graphical, and geographical distribution content to provide users with information on the type of animals (including dangerous ones) that inhabit Australia. The application demonstrates how content typically found in a museum can be brought into a school classroom in a fun, educational, and interactive manner. As shown in Figure 1A, students interact with the whiteboard via touch, and the main functionality provided by the application is that of an animal reference guide, in which users can lookup details of an animal based on its name, species, location, and danger rating. The location feature (Figure 1B) is particularly relevant as this allows the user(s) to view content specific to their own particular region. The information on each animal is divided into topics. These include: identification, distribution, feeding and diet, and treatment (e.g. from bites or stings from the animal). These topics are presented to the user via a large content pane as shown in Figure 1C and the animal images can also be viewed via an image gallery (Figure 1D).

The presentation of content in this application is adapted in a number of ways to cater specifically for the target user group (i.e. school students), the situational context (i.e. classrooms), and the device's capabilities (i.e. touch whiteboard and projection technology). In particular, to cater for the application's intended user group, a bright colour scheme and font style has been used, and this is accompanied with colourful animal illustrations and a set of icons oriented towards children (e.g. see the "footprint" buttons in Figure 1B). To cater for the application's intended situational context, the application supports both teacher-mediated and self-mediated interaction. In particular, a typical usage of the application is such that a user standing in front of the board looks up details for a particular animal. The large font size and user-interface elements (e.g. lists, content panes, and buttons) additionally make it possible for people situated further away from the board (e.g. sitting on the floor 1-2m away) to also read the content. In addition to the 'lookup' operation, there are also

quizzes in which the student (or teacher) is able to test how much has been learnt about a topic. The quizzes that were developed as a proof-of-concept for the application include multiple choice questions (e.g. 'What is the size of a female redback spider?'), true/false questions (e.g. 'Funnel-web occurrence is low in much of central-western Sydney, right?'), and game-like questions that require a user to find an animal within a particular scene, or identify whether an animal is dangerous or not (see Figure 1E). The underlying hardware capabilities of the application (i.e. single-touch interaction and a projected display of 1024x768 pixels) meant that the application has been designed for single-user operation (e.g. in comparison to collaborative tabletop surfaces that need to support multiple users simultaneously as in [3]). Furthermore, much of the UI design leverages guidelines that are emerging for interactive TV applications (e.g. Google TV's design guidelines[3]), like the large fonts and graphics needed to account for people sitting proportionally farther from the display than with a traditional desktop computer, and the division of content into easily consumable segments that require only minimal or no scrolling.

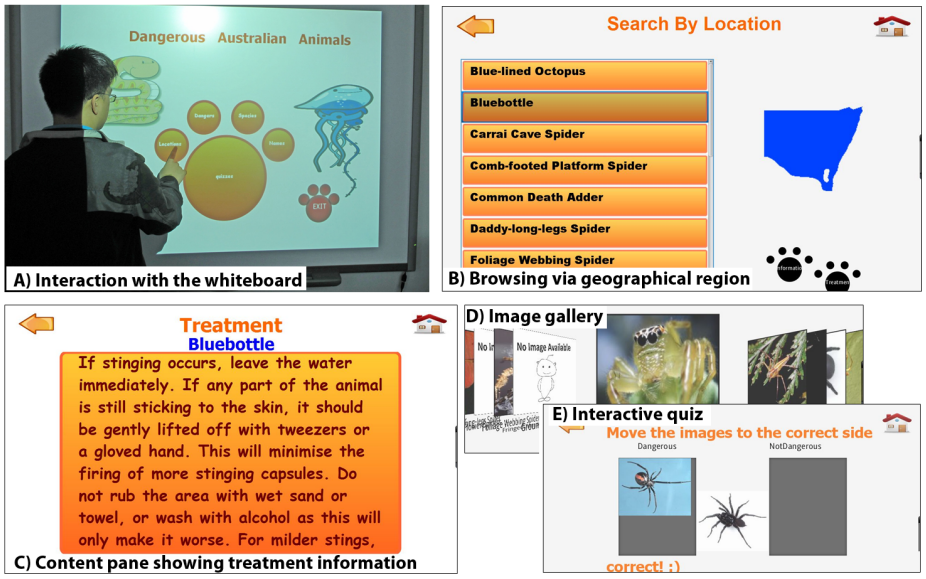

Fig. 1. The Dangerous Australians interactive whiteboard application, showing user interaction with the whiteboard (A), browsing via geographical region (B), treatment information for a particular animal (B), the animal image gallery (D), and one of the various quiz types available in the application (E).

[3] Google TV Design Guidelines, URL: http://developers.google.com/tv/web/docs/design_for_tv.

3.2 Dangerous Australians as a Mobile Device Application

Similar to the interactive whiteboard application, the Dangerous Australians mobile application (Figure 2) uses textual, graphical, and geographical distribution content to provide end-users with information on the type of animals (including dangerous ones) that inhabit Australia. In contrast to the whiteboard application, which specifically targets classroom students, this application targets a more general audience, and in particular, users local to the region (including museum visitors and the general public) and those from afar (e.g. tourists). Also in comparison to the whiteboard application, which primarily serves as an educational tool, this mobile application has been designed to be a quick and easy reference guide that provides access to animal content based on the user's situational context (i.e. geographical location). The other notable difference between the two applications is that this application is designed for use on a small-screen touch display rather than a large interactive wall display.

Fig. 2. The Dangerous Australians mobile phone application, showing the startup page (A) and the location (B), nearby (C), and identify (D) features.

Being designed for mobile phones[4], this application leverages some of the personalisation aspects that are intrinsically supported by such mobile devices. In particular, users of the application are able to determine which dangerous Australian animals are known to inhabit the area "nearby" (see Figure 2B). This is determined by comparing the current position of the user with each animal's geographical distribution, which is defined by a set of polygon coordinates in the database. In addition to the "nearby" feature, users are also able to "lookup" details about the animals (Figure 2C), including the topics described earlier for the whiteboard application like: identification, distribution, and what to do if

[4] This application has since been commercialised and can now be found on the Apple AppStore under the name DangerOz.

bitten by such an animal. A final feature supported by the prototype version of this application is that of animal "identification", in which users can take a photo of animals that they find in their surrounding environment and email it to the museum's experts for identification (Figure 2D).

3.3 Content Reuse and Repurposing for Different Device Form-factors and Interaction Paradigms

The previous section outlined the various functionalities of the two different applications and the manner in which the applications are able to adapt a single-source of content to the specific needs of their target audience. However, supporting applications across multiple platform configurations is an expensive task, both in terms of the initial design and implementation of the application, and in terms of the ongoing maintenance required by such applications. As such, a second goal of this work is to begin establishing best practices for the reuse of content across devices of different form-factors and interaction paradigms.

As described in [15] adaptive content delivery aims to provide universal access to multimedia information in a heterogeneous network environment, by accommodating the special needs of users and the constraints of client devices and network characteristics. Within a web context, the W3C [13] outlines the goal for ubiquitous web access as being "to access any information over any network from anywhere through any type of client device". In this section we outline - based on our experience in implementing the above two applications - the challenges that arise when designing an application for devices of substantially differing form factor, and we also outline the strategy employed in our own implementations.

The task of content adaptation and delivery is commonly divided into two sub-tasks, namely "content reuse" and "content repurposing". As defined in [8, 9], 'content reuse' refers to the practice of using existing content components (e.g. text, images, audio, video) to develop new documents, and 'content repurposing' refers to the process of converting, modifying, or otherwise changing the presentation style of a content component to suit specific device, network, and user needs. Much of the past work in content repurposing platforms (e.g. see the Volantis[5] and WebSphere[6] platforms) has focused on the repurposing of content for web browsers. Solutions based on web standards and web browsers do have the advantage that they are cross-platform, but they also have disadvantages associated with them when compared to native implementations. Some of the disadvantages common to content-repurposing platforms and also some cross-platform toolkits (e.g. web-to-native wrapper frameworks, runtime environments, and source-code translators; see [5] for a deeper analysis) include slower runtime performance, limited UI capabilities, and limited access to device APIs [5]. These limitations are often compounded in that many device form factors - like smartphones, tablets, tabletops, wall displays, and interactive TVs - are

[5] Volantis Mobility Server, URL: http://www.volantis.com.
[6] IBM WebSphere, URL: http://www.ibm.com/websphere.

still emerging and interaction paradigms are still in the process of being defined, and so cannot realistically be integrated into existing web standards.

The middle-road that was taken for the implementation of our two museum applications was to use a single-source of content (i.e. in our case an SQL database) and to incorporate the use of a server-side RESTful web interface to access this single-source of content. In this approach, the application logic is embedded in the natively compiled applications (Java for the whiteboard application and Objective-C for the mobile application) and the RESTful webserver is used as an interface to access this content via JSON queries.

Although our two museum applications are implemented natively, and are thus able to harness the performance, UI, and device resources available to them, the main principles common to content reuse and repurposing have still been adhered to. In particular, the content stored in our database can be seen to be comprised of individual textual fragments, with each fragment typically corresponding to a self-contained element like a textual paragraph or a picture; this methodology aligns with the 'fragment-variant approach' to content reuse as defined in [1]. Similarly, and as outlined in the Volantis[12] approach to content repurposing - in which web pages are repurposed based on content, page layout, and style guides - care was taken to separate the content from the presentation and interaction aspects of the applications. This is also shown in Figure 3, in which the content panes and navigational buttons for our mobile and whiteboard applications are shown; in particular, the mobile application has fewer buttons and more content to scroll through in the content pane compared to the wall display which has a scrollable list of buttons for each of the topic segments and a content pane that requires only very minimal or no scrolling at all.

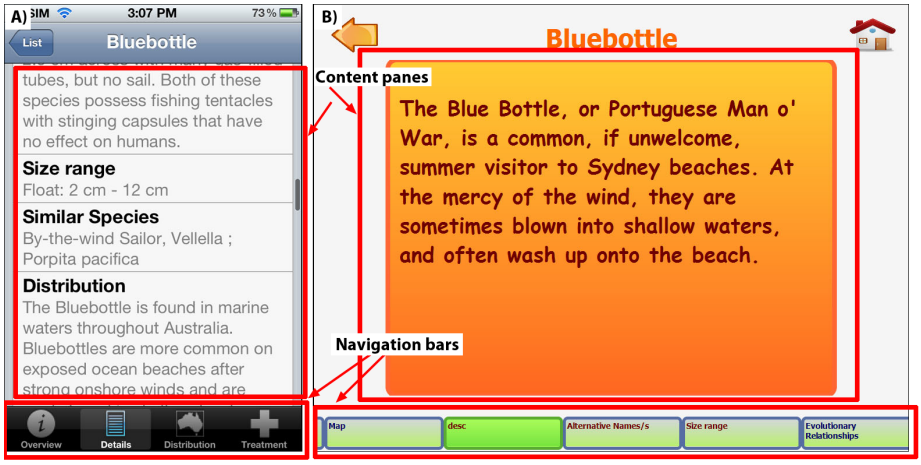

Fig. 3. The content panes and navigation bars used in the mobile (A) and whiteboard (B) applications.

4 Discussion and Future Work

The two museum applications described in this work show how a single source of content can be adapted to cater for the specific needs of widely differing audiences. However, in our implementation, content adaptation is tightly bound to the respective platforms and their target user groups. Future work in adapting and personalising the content in these applications will now focus on the integration of parallel work that is being carried out in life-long user-modelling [14, 4, 6]. Integration of such user models will for example allow the mobile application to augment a user's physical visit to the museum, e.g. by providing detailed additional information on the museum's physical exhibits, and/or in providing suggested tours based on animals that the user has expressed interest in. Integration of a user modelling framework will also provide the whiteboard application with the ability to cater for different user groups (e.g. children and adults) and more targeted interactive quiz possibilities.

Similarly, our work into content reuse and repurposing has shown that it is possible to leverage some design principles from cross-platform development approaches, such as the separation of content from program logic and presentation/interaction components, but that there are trade-offs with existing approaches to content-repurposing platforms and many cross-platform toolkits. These trade-offs are particularly relevant to newly emerging device form-factors like smartphones, tabletops, wall displays, and interactive TVs in which the interaction paradigms are still maturing. Future work will now look at establishing guidelines on how to translate user experiences across different device types, and including also touch-based, gesture-based, and remote-based interaction paradigms.

5 Conclusions

This paper has outlined how museums can reuse a single-source of content to target multiple applications with widely varying interaction experiences and associated target audiences. Furthermore, our preliminary work has shown a number of ways in which such content can be personalised to cater specifically for different users and their situational contexts. This work will form the basis for our further research into interactive museum experiences, incorporating the aspects of content-reuse and repurposing, user-modelling, and personalisation.

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