School of Rock Art: An Online Flipbook Viewer and Editor for Bushman Stories

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	Category	Min	Max	Chosen
1	Requirement Analysis and Design	0	20	15
2	Theoretical Analysis	0	25	0
3	Experiment Design and Execution	0	20	15
4	System Development and Implementation	0	15	10
5	Results, Findings and Conclusion	10	20	10
6	Aim Formulation and Background Work	10	15	10
7	Quality of Report Writing and Presentation	10		10
8	Adherence to Project Proposal and Quality of Deliverables	10		10
9	Overall General Project Evaluation	0	10	0
	Total marks	**80**		**80**

Abstract

In South Africa, the term 'heritage' is more often associated with contemporary art, music and dance than with the nation's rich archaeological past. However, this rich archaeological past, which includes rock art, is an important part of the nation's history. A need therefore exists to educate people about the importance and wonder of this past, and in particular to teach them about rock art, as well as the people who created the art. For this reason, the School of Rock Art (SORA) website was created. This site allows users to explore 3D visualisations of caves containing rock art, experience guided tours of rock art, and read Bushman stories that are illustrated with rock art images.

The focus of this report will be the storytelling feature of the School of Rock Art site. This feature allows users to read Bushman stories in a flipbook format, as well as to edit these stories to include relevant rock art images and various text styling. The aim of this feature was to create an engaging and dynamic storytelling environment to encourage learning about rock art. The results of user evaluations carried out on this feature show a positive result in achieving this aim.

Acknowledgements

First of all, I would like to thank my supervisor, Dr Hussein Suleman, for his continued assistance, support and encouragement. You have been a true mentor and inspiration to me. Thank you for always believing in me, even when I doubted myself.

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To the Computer Science honours class of 2012, thank you for all of your moral support. Each of you have, in your own way, made this year as great as it was. We have made it through late nights together, more writing and presentations than ever before and ultimately come out all the better for it.

Last, but certainly not least, I would like to thank God, my parents, John and Diane, my brother, Robert, and my boyfriend, Roberto de Abreu. Thank you for all your love, support and encouragement. I would not be where I am today without you, thank you always and forever.

Contents

List of Figures

Chapter 1

Introduction

The preservation of heritage is an important concern throughout the world. Rock art is a unique part of heritage, which offers many research and educational opportunities. Technologies such as laser scanning and 3D modeling techniques provide a way of accurately documenting rock art, as well as aiding in its preservation. Additionally, technologies such as virtual reality and Web based systems also have applications towards educating people with regards to rock art. These technologies can provide a way for people to experience and interact with rock art sites without having to physically visit the sites. Furthermore, there are applications for incorporating rock art with traditional stories from different cultural groups. In this way, people can learn about the heritage, beliefs and culture of these cultural groups from the narrative of their stories and the visual of the rock art images they have created.

1.1 Problem Statement

The Archaeology department at the University of Cape Town has compiled a large amount of data concerning rock art. This data includes laser scans of rock art shelters, images of various rock art and site information from a range of rock art sites in the Western Cape. At present this information is not being used, other than for research purposes. The information would, however, be an extremely useful source for educating the public, and in particular school children, about rock art and the heritage of the people who created the rock art. The problem that exists, however, is that no tools exist for showcasing this information in a useful and educational way.

1.2 Motivation

The motivation for the School of Rock Art project is to address the problem statement by creating a useful tool to display and query information about rock art. The tool that was created was a website consisting of three parts:

- **Cave Navigation**: Developed by Kaitlyn Crawford, this component allows users to explore 3D visualisation of caves containing rock art.

- **Guided Tours**: Developed by Marco Lawrence, this component allows users to view predefined tours containing information and images of rock art that are related to specific topics. Users are also able to create their own tours.

- **Story Telling**: Developed by Joanne Marston, this component allows users to read Bushman stories that have been translated to English. Users can also edit the stories by adding rock art images and changing the appearance of the storybook. This component is described and discussed in this report.

It is intended that the project be of use to people who are interested in learning about rock art and the stories of the people who created the art.

1.3   System overview

The School of Rock Art project, as mention above, is a website consisting of three parts. Each of these parts is accessed from the project's home page, with links within each part back to the home page or to either of the other two parts. A diagram of this structure is summarised in Figure 1.1.
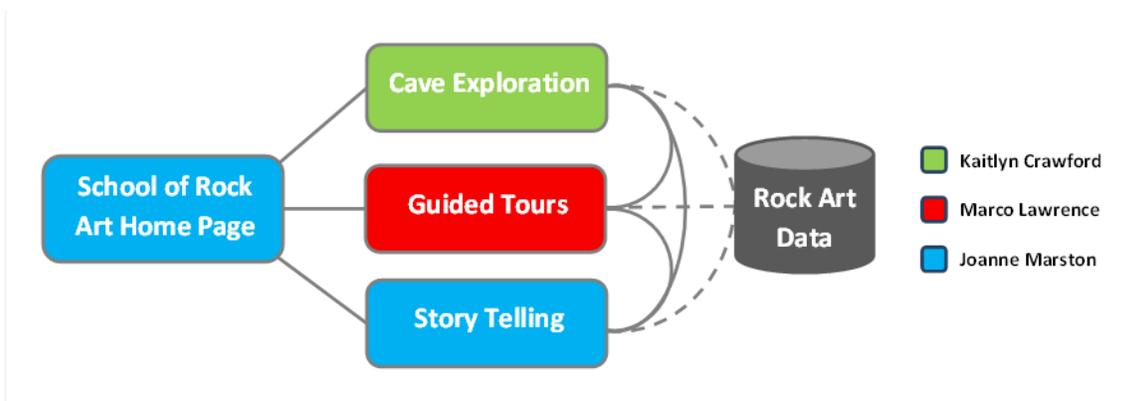
Figure 1.1: Overview of system design. Lines represent links between components.

This report contains details of the Storytelling component of the project.

1.4   Research Question

The research question that the Storytelling component of the School of Rock Art project seeks to address is:

Is it possible to build an engaging and dynamic storytelling environment to encourage learning about rock-art?

In answering this question, user satisfaction with the system was evaluated, as was the ability for users to dynamically create and edit stories.

1.5   Data Description

Data from the archaeology department was used in this project. The data consisted of a large number of images organised in folders. The file structure of the data is as follows:

Root Folder - Map Sheet
    -> Level 1 - Farm/Kloof or other naming sequence by which sites are named

-> Level 2 - Site Number
    -> Level 3 - General - directory for general images of area which are not site specific or unmatchable data, site reports or images
    -> Level 3 - Recorder/Contributor/Project - directory into which images and reports are stored

Level 3 directories contained metadata files with the details of a particular site, including whether rock art images were found at the site. The files contained XML tags with the number of antelope, rhebuck, eland, hartebeest, elephant, zebra, bird, ostrich, sheep, feline, wildebeest, buffalo or rhino rock art images that had been found at the site. There was no information about the contents of the individual photos of a site.

1.6   Ethical, Professional and Legal Issues

As evaluation of the system will involve user testing, Ethics Clearance was obtained from both the Science Faculty Ethics Committee and the Department of Student Affairs. All information collected from participants during user testing is kept strictly confidential and user evaluations are kept anonymous.

With regard to legal and copyright issues, all jQuery plugins used were available under open source licences, including the non-commercial BSD license, MIT license and the Apache license. The images used to represent each component of the School of Rock Art project were adapted from svg images that have been released to the public domain. The fonts used to create the School of Rock Art logo are also available freely under open source licences. All of these items were used for research purposes only and there are no intentions of releasing this system commercially.

The Bushmen stories used in this project were sourced from the book "Specimens of Bushman Folklore" by W. H. I. Bleek and L. C. Lloyd. Various versions of this book are available freely from the Internet. Permission to use the the rock art images that are available for insertion into stories was provided by the Archaeology department of the University of Cape Town.

1.7   Report Outline

This report describes the Storytelling component of the School of Rock Art project. Chapter 2 provides background information on rock art heritage, preservation and education and its link to digital storytelling. Thereafter the design and implementation of the system are explained in Chapter 3. An evaluation of the system by user testing, and the results of the evaluation, are detailed in Chapter 4. Finally, Chapter 5 contains the conclusions of this report and Chapter 6, suggestions for future work.

Chapter 2

Background

2.1 Introduction

Rock art is found throughout the world, with the greatest variety and some of the oldest art being found in Africa (Clottes 2007). Unfortunately, rock art sites are in danger of disappearing (Wasklewicz et al. 2004). New technologies are providing ways of accurately recording these sites, not only for research purposes, but also to create a virtual record. This virtual record is a way of preserving these sites and of allowing access to information that could otherwise only be obtained by visiting the site itself (Rajan & Rüther 2007).

This chapter discusses rock art heritage and preservation, as well as rock art education. Furthermore, the traditions of storytelling are investigated and linked to the images that are often depicted in rock art. The aim of this is to create a form of digital storytelling that uses both the stories and the images of the rock art to create a unique storytelling experience.

2.2 Rock Art

2.2.1 Rock art heritage

In South Africa the term 'heritage' is more often associated with contemporary art, music and dance than with the nation's rich archaeological past (Meskell 2005). However, this rich archaeological past, which includes rock art, is an important part of the nation's history. The department of rock art at the National Museum in Bloemfontein states that the term rock art refers to images that are painted onto, engraved into or sculpted out of a rock art surface. Furthermore, it is an archaeological artifact that can help us understand more about its creators (National Museum 2012). Rock art therefore provides a unique and striking way of learning about the early history of South Africa.

Rock art sites are scattered throughout South Africa, but the focus of this project will be on those located in the Western Cape, in particular those found near the town of Clanwilliam. The rock paintings in this area range in age from 8 000 years to 100 years (Khoisan Rock Art in the Cederberg Conservancy 2012) and depict art of the San people, who lived throughout South Africa for tens of thousands of years before European colonisation (Vergnani 1999). The art ranges from that of animal scenes to scenes of humans hunting, gathering food or dancing in procession. Images of therianthropes (half-animal half-human figures) are also present and are thought to have important religious meaning (Khoisan Rock Art in the Cederberg Conservancy 2012).

2.2.2 Rock art preservation

Rock art is an important aspect of heritage, one that needs to be preserved. Nelson Mandela, writing for the Trust of African Rock Art (TARA), emphasised that for future generations to experience, study, and contribute to our understanding of Africa's history, the rock art of the continent must be preserved and protected (Clottes 2007). Unfortunately, rock art sites are being destroyed, not only in South Africa but throughout the world, and thus there is a need to not only protect, but also assess and record sites in order to preserve the information for future generations (Wasklewicz et al. 2004).

There will always be a need for the preservation and conservation of rock art sites. Technology provides a means of creating an inventory of the increasingly threatened cultural heritage of the world (Ogleby 1995). Laser scanning is a technique that is being used to record rock art sites. Its main advantages are that it is accurate, non-destructive and scalable. The scanned data can be used to create 3D models, which can be used to identify any impacts to sites over time (Wasklewicz et al. 2004), as well as aid in planning and management of restoration efforts (Rajan & Rüther 2007). Rock art sites can thus be preserved in a digital form that is unaffected by the issues that actual sites face, namely impact from the elements, vandalism and mass tourism. Furthermore, the accuracy of the data provides information that is sometimes difficult, especially to the untrained eye, to see or experience at the site itself (Martinez 2001). This is aided by the advancement of digital image processing. Rock art images can be enhanced to show more detail and features can be automatically extracted for easier analysis and identification of archaeological characteristics (González-Aguilera et al. 2009).

Aluka[1] is an online digital library of scholarly resources from and about Africa. The African Cultural Heritage Sites and Landscapes content area is an attempt to use 3D visualization and spatial documentation technologies (such as laser scanning) to create an online archive of information about African cultural heritage sites and landscapes (Rajan & Rüther 2007). The aim is to advance research and conservation efforts, while at the same time creating a permanent record of Africa's diverse heritage. Among the information collected there is an immense collection of images of rock art, as well as scans and documentation of five rock art shelters and caves in the Cederburg Mountains (Rajan & Rüther 2007).

2.2.3 Rock art education

Rock art education is one way of trying to ensure rock art preservation (Clottes 2007). Information on rock art is widespread and freely available. Online digital libraries, such as Aluka, have a wealth of information on the topic. The digitisation of the information is allowing many people access to resources that would otherwise be out of their reach (Rajan & Rüther 2007). Furthermore, it provides useful features such as text searching, filtering options and the display of related information.

Educational software concerning rock art is also available, such as "Exploring Rock Art: A North American Field Trip" which allows students a variety of learning opportunities (Olivier-Hirasawa 2001). The program has different sections, including "Explore Rock Art" in which students can visit different sites in North America to see images of rock art, as well as take pictures of the rock art. There is also a research section with various research tools, including reference books and links to Web sites, as well as a section in which students can develop a rock art museum exhibit (Olivier-Hirasawa 2001).

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[1]http://www.aluka.org/

Rock art education of local communities has the benefit of providing them with both the knowledge of how to ensure that the heritage surrounding them is kept intact (Clottes 2007), as well as the potential for job creation (Parkington 2007). The Clanwilliam Living Landscape Project (CLLP)[2], for example, is a community based heritage and education project. Its aim is to use archaeological research to develop school curricula that incorporates archaeological materials and exercises. Furthermore, it aims to train local people as guides, craftspeople and heritage managers (Parkington 2007).

Rock art education does not have to only deal with the art itself, it can also focus on the people who created it. The San (also known as Bushman) are an indigenous group of people from southern Africa whose populations decreased dramatically after the start of European colonization in the late 1400s (Ladeira et al. 2010). The San are famous for their rock art, but also have a rich oral culture that is accompanied by a tradition of storytelling (Guenther 2006).

2.3 Storytelling

2.3.1 The tradition of storytelling

South Africa has a rich heritage of oral tradition, with many African cultures being described as primarily oral: knowledge is preserved by telling rather than writing (Ladeira et al. 2010). San culture has an oral nature, which is evident from studies of San stories and storytelling (Guenther 2006). There are a large number of San tales, which vary not only in the tales themselves, but also in versions and variants (Guenther 1999). Many of these tales can be related to and make use of the images depicted in the San rock art.

2.3.2 Digital storytelling

Leslie Rule, from the Digital Storytelling Association, describes digital storytelling as being the modern form of the ancient art of storytelling (Digital Storytelling Association 2011). It can take many forms, such as a collection of still images, joined and overlaid with a voice narrative (Ladeira et al. 2010), text Web pages, an interactive website, a song, a video, a game or a virtual reality world (Xu et al. 2011). Each of these forms has both its pros and its cons. A text-based approach is fairly easy to implement, but provides a low degree of immersion in the story. According to Search (2009), a user should be able to feel and experience what is being conveyed, as opposed to just reading about it. Additionally, written texts are not able to portray certain aspects of oral storytelling, such as repetition, long pauses, abrupt phrasing, high and low tones of voice, and a general sense of timing (Eder 2007).

An interactive website can provide a higher level of immersion and provide a unique viewing experience. One such website is Ashes and Snow[3] (Search 2009), which features the work of award-winning Canadian photographer Gregory Colbert. The explore function of the website (under the enhanced experience section) presents a unique type of audio-visual narrative that creates an immersive cultural experience for the user. Users interact with the content (photographic content and short film clips of people and wild animals) by moving the mouse over the screen to create a trail of thumbnail images (shown in Figure 2.1). These images fade in and out, creating a sense of being immersed

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[2]http://www.cllp.uct.ac.za/index.htm
[3]http://www.ashesandsnow.org

in an ethereal world. The addition of poetic voice overlays adds to this effect. These effects allow the user to interact with the cultural experience that is being shown and immerses them in the environment.

Figure 2.1: Screen-shot from the Ashes and Snow Website

Another technique that allows for a high level of immersion is that of virtual reality, which makes use of computer graphics to provide the effect of immersion in the virtual environment (Pan et al. 2006). As virtual reality is interactive, it has the potential of creating an effective way of engaging a user and giving the sense of actually being a part of the story, or the storytelling experience itself, a feeling known as presence (Lesaoana 2004). It also allows for the recreation of realistic sites, including historical sites and artifacts (Lesaoana 2004)(Ladeira et al. 2010), and thus provides a way of creating storytelling experiences that are authentic. Furthermore, there is the possibility for direct interaction with the natural world, something that can enhance a story that is being told (Eder 2007).

The paper "Digital Storytelling in Africa" (Ladeira et al. 2010) describes the creation of two virtual reality prototypes that tell the San story of Kaggen the Mantis, the classical trickster figure of San mythology. The first prototype focused on how sounds and visuals can influence a user's experience of the story. The prototype was simple and featured a group of hunters in a cave sitting around a fire. One of the hunters told the story to the user and the other hunters. San rock art illustrating some of the story events was depicted on the cave wall nearest to the storyteller and as the story was told a light would illuminate the picture relating to the part of the story currently being told (shown in Figure 2.2). Audio effects were also used in the form of ambient content, such as the crackling of the fire. It was found that both the use of the visual content (the rock art) and the ambient noises increased the enjoyment of users, as well as their sense of presence (the extent to which they felt as though the virtual environment was real).

The second prototype dealt with a more authentic and realistic version of the virtual environment. It dealt with comparing a virtual reality implementation to that of a text-based implementation. The results, based on experiments using high school students, showed that although the text-based system provided a higher level of comprehension of the story, the VR system provided a greater

Figure 2.2: Screen-shot from the first prototype created in "Digital Storytelling in Africa" (Ladeira et al. 2010). The figure shows rock art depicting events from the story being told.

level of enjoyment, less boredom and confusion, in addition to a greater interest in San culture (Ladeira et al. 2010). It can therefore be seen from both prototypes that VR can be a powerful tool for engaging a user in the full storytelling experience.

It terms of creating a form of digital storytelling suitable for depicting the culture and stories of the San people, there are thus many options available. Visual anthropologist Roderick Coover (2001, cited in Search 2009) believes that one should experience a culture through different forms of sensory input. Input of images, text, sound, rhythm, action, light, and colour can together create an environment that provides a particular cultural experience and allows the viewer to interpret their own meaning, relationships and cultural values. This implies that the final product should be one that uses a variety of techniques to engage the user in the story being told.

2.3.3 Education through digital storytelling

In terms of education, it has been found that digital storytelling can be a useful teaching method for both gaining and holding a student's attention (Xu et al. 2011). Digital storytelling is said to enhance the convergence of four student-centered learning strategies (as depicted in Figure 2.3): student engagement, reflection for deep learning, project-based learning and technology integration into the classroom (Barrett 2006).
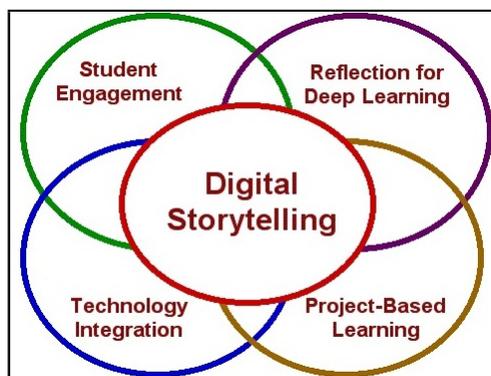
Figure 2.3: Convergence of student-centered learning strategies (Barrett 2006)

Educational digital storytelling usually involves a student creating a digital story. This can be in the form of a short movie clip or a compilation of still images with audio overlay. More recently, research has been done on letting students create a digital story in a virtual environment, with the online world of Second Life[4] often being used for the creation of these stories. This world allows users to create an experience or even a viewing space where others can walk through their stories. In a survey conducted by Shin and Park (2008, cited in Xu et al. 2011) to study digital storytelling in a virtual environment, it was found that students were more engaged and enthusiastic about participating in the construction of the environment of the story, as opposed to simply listening to it, or listening and interacting with it. Digitally storytelling thus, whether it is in a VR form or something simpler, provides students with a new and interesting way of expressing themselves and learning at the same time.

2.4   Discussion

Rock art is a fascinating art form that provides us with a window into our past. Likewise, storytelling gives us the narrative to this window. Both rock art and the stories that accompany it need to be preserved and documented, both for research and educational purposes. Technology provides us with a unique way of doing this. Various techniques, such as laser scanning, exist for the collection of the data, while digital libraries are available for the storage of the data and the World Wide Web for providing a way of distributing the data.

The problem of the information often being static or hard to visualise can be solved by creating an environment that engages the user and immerses them in the information. Techniques such as interactive Web sites and virtual reality can aid in doing this. These techniques also have applications in education. Students are more inclined to learn if they are enjoying themselves and interacting, as opposed to reading through copious amounts of text.

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[4]`secondlife.com`

Chapter 3

Design Chapter

This chapter outlines the design of the system. Section 3.1 describes the design principles that were followed, while Section 3.2 details the tools and techniques used in the creation of this system. Sections 3.3 and 3.4 describe the design of the system in terms of the design process and the final design respectively.

3.1 Design Principles

When designing a Web interface, there are a number of design principles that should be followed in order to maximize usability. The following principles were taken into account during the design of the system:

3.1.1 Simplicity

According to Friedman, the Keep It Simple (KIS) principle should be one of the goals of site design. The reason for this is that people visit a site for its content, not for its design (Bradley 2011). Keeping things simple also follows Hick's Law, which states that: The time it takes to make a decision increases as the number of alternatives increases (Mason 2010). Providing a user with too many options will thus make the website more difficult to use and discourage users from visiting the site again (Laja 2012).

3.1.2 Visual Hierarchy

Visual hierarchy is the order in which the human eye perceives what it sees (Laja 2012). This is important in Web design as it determines which elements a user is more likely to focus on first. Important information should thus be higher in the hierarchy to draw attention towards it. This can be achieved through the effective use of size, colour, contrast and alignment (Jones 2011).

3.1.3 Scannability

Users do not often take the time to completely read a Web page, but rather skim over the information before performing their next navigation action (Weinreich et al. 2008). This scanning behaviour has also been described by Morkes & Nielsen (1997) and Spool (1999) and indicates that the scannability of information is important for the usability of a Web page (Weinreich et al. 2008).

Eyetracking visualizations have also shown that users often read Web pages in an F-shaped pattern

(Two horizontal stripes, followed by a vertical stripe) (Morkes & Nielsen 1997). The implication of this is that important information should thus be contained in the first two paragraphs and at the beginning of subheadings, paragraphs and bullet points.

3.1.4   Above the fold

"Above the fold" is newspaper terminology that refers to the most important information being placed on the front page and above the fold of the newspaper in order to grab people's attention (Spool 1999). Similarly, the first screenful of a website's homepage is the most important part of the site as it will determine whether a user decides to stay on the site or not (Robbins 2001). Additionally, if a Web page does not fit entirely on the screen, a user will have to navigate it by scrolling. Scrolling can however be considered a usability challenge as it can result in disorientation if a reader loses track of header or navigation elements that have moved off the screen (Weinreich et al. 2008). For this reason, guidelines recommend that, for entry and navigation pages, the whole page should fit on the screen in order to show all the options immediately (Lynch & Horton 2009).

3.1.5   Navigation

According to Weinreich et al. (2008), about 45% of selected links on a page reside in the upper left quarter of the browser window. Placing important links in this area will thus increase consistency and aid navigation on an unfamiliar site.

3.1.6   Law of Proximity

People tend to group things together if they are close together in space. In Web design it is important to group certain elements together, such as navigation links and header or footer information (Laja 2012). It is equally important to ensure that elements that do not go together are not perceived as one, as this can make some elements hard to find and cause confusion.

3.1.7   Consistency and Smooth transitions

Consistency across pages in a website creates smooth transitions from one page to the next, reassures users that they are still on the same site and aids them in finding information (Sklar 2008). This can be achieved by using the same colours, font and page layout throughout the site. Navigation elements, especially, should be placed in the same position on each page as users will quickly orient themselves to this structure.

3.2   Tools and Techniques

3.2.1   Languages and APIs

HTML and CSS

A Web-based system was chosen for this project in order to ensure that it would be widely accessible, particularly by schools. There was a focus on using HTML5 and CSS3 features as these are the new standards for HTML and CSS and offer a range of new features. The new HTML5 contenteditable and spellcheck attributes, for example, were of particular use for this project. The contenteditable attribute specifies whether the content of an element can be edited, while the spellcheck attribute specifies whether an element's spelling and grammar is checked (W3Schools 2012). Another reason

for using HTML5 is that these features do not require any third party plugins, such as Adobe Flash player, to be installed in the browser. Research has shown that users are not likely to install browser extensions as they are difficult to choose and install for many people (Weinreich et al. 2008).

Client-side: jQuery

jQuery is a Javascript library that simplifies Javascript code and provides fast and concise HTML document traversing, event handling, animation and Ajax interactions (jQuery Foundation 2012). Additionally, it is free to use, backed by a powerful community of developers, supports a range of plugins to enhance functionality and is supported by comprehensive documentation.

The following jQuery plugins were used:

- turn.js : To create a flipbook effect.

- bxSlider: To slide between pages in design mode.

- spectrum: A colour picker for selecting page and background colours in design mode.

- fcbkselection: An image selector for choosing an image to insert in design mode.

- bootstrap: To create popups and other user interface elements.

Client-side and CSS: Bootstrap

Bootstrap is a intuitive and powerful front-end framework developed by Twitter for fast and easy Web development (Twitter 2012). It provides sleek CSS styling, as well as custom Javascript plugins for user interface elements, which integrate smoothly with the aforementioned CSS.

Server-side: PHP

PHP is a scripting language that is particularly useful for Web development (Group 2012). It is open source and easy to learn. It is also compatible with almost all servers, including Apache, which was used to test and host the system, and runs on different platforms. Furthermore, it is well-documented, updated regularly, and has good community support (Torres 2012).

3.2.2   Browser Choice

Chrome was decided upon as the browser of choice for this project. The reason for this is that, currently, the latest version of Chrome (Chrome 22) scores the highest in terms of support for HTML5 (Leenheer 2012). Chrome 22 scores 434 points out of a maximum of 500 points, as well as 13 bonus points for additional support of features such as SVG and MathML and support of different codecs for the audio and video elements of HTML5. Chrome versions 16 to 22 in fact all score higher than the closest competitor, Opera 12, which scores 389 points.

Chrome developer tools were also invaluable for the design and implementation process. They are built-in and provide tools for inspecting, editing and debugging website code.

3.2.3   Server Used

The system, as well as the archaeological data used, was hosted at "http://simba.cs.uct.ac.za". This server runs Apache on Linux. A local Apache server was also used for testing purposes.

3.3   Design Process

An iterative design process was chosen for this project. According to Ramsay (2009) there are three reasons for designing iteratively:

1. Discover problems earlier

2. Get reliable user feedback

3. Spend less time documenting, more time designing

This type of process was thus well suited to that of an Honours project and in particular one such as this. For this project three iterations were created. The feedback from each stage was used to influence the next stage of development. The details of this process can be found below.

3.3.1   Iteration 1 (Prototype)

The first prototype of the system consisted of a simple page to display a story. The story had two view modes, namely a flipbook view and a slide view (See Figure 3.1). In the flipbook view the story was displayed in a traditional book format. Users were able to turn pages by clicking or dragging the corners of the pages, or alternatively using the arrow keys on the keyboard. When a page was turned, the book was animated to resemble the look of a page in a paper-based book being turned.
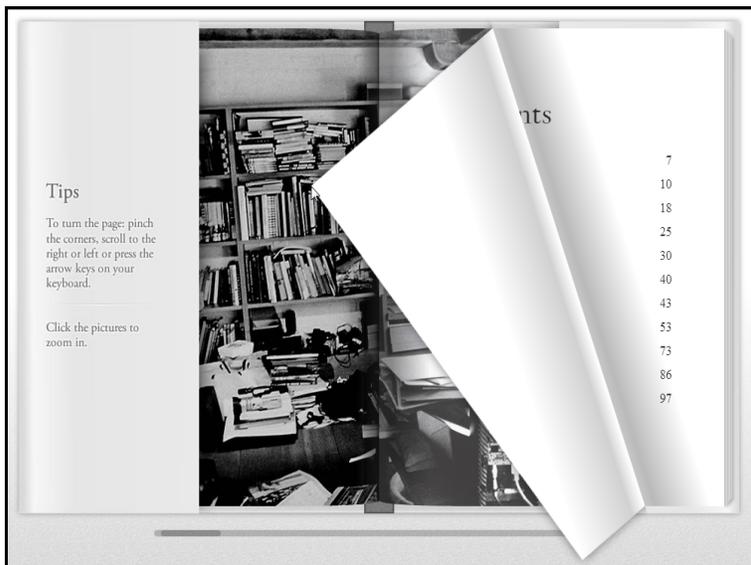

Figure 3.1: Iteration 1: The two view modes, flipbook and slide view

In the slide view, pages of the story were displayed one at a time. To navigate between pages a user could use a swipe gesture with the mouse or use the keyboard arrows. The swipe gesture worked both when using a mouse on a desktop computer and when using touch input on a touch device such as a cellphone or tablet. Pages would change by simply sliding across the screen from the previous page to the next.

Feedback

This prototype was shown to our client who was happy with the basic concept of the design. A wealth of additional information that could be added to a story was suggested, such as quotes, sketches and videos. An interesting Workspace feature was also suggested. The Workspace would be a panel that would slide out and allow users to record information. Users would, for example, be able to write down their thoughts, drag content from the page into the workspace and so on.

The prototype was also shown to a group of three first year students in order to gain feedback on the design. First year students were chosen as they were the closest available students to the target audience of High School learners. Of the two views, the flipbook was preferred, provided that the effect was not slow to transition between pages. The students liked how realistic the animation of turning pages looked. It was suggested, though, that there should be navigation controls allowing a user to go to a particular page.

The students also liked the idea of the workspace. Additional features suggested included:

- Slide out information panel

- Dictionary functionality

- Search functionality

Unfortunately, due to time constraints, it was decided that the workspace feature, as well as the other features suggested, would be future work.

3.3.2   Iteration 2

Iteration 2 consisted of improving the display of stories, as well as designing and implementing the option to edit/design stories. For the display of stories, it was decided to focus on the flipbook view as users seemed to prefer this view. For editing stories, it was decided upon to display the text in contenteditable DIVs to allow a user to edit the text of the story. The reason for using the contenteditable property as opposed to a textarea was to allow the user to format the text with different styles, such as Bold and Italic. In a textarea, for example, bold text would be displayed as ⟨b⟩This text is bold⟨/b⟩ as opposed to the desired effect of **This text is bold**. Styling of text was also easily accomplished in a contenteditable DIV by using the functionality of the HTML editing APIs (W3C 2012b), in particular the document.execCommand functionality.
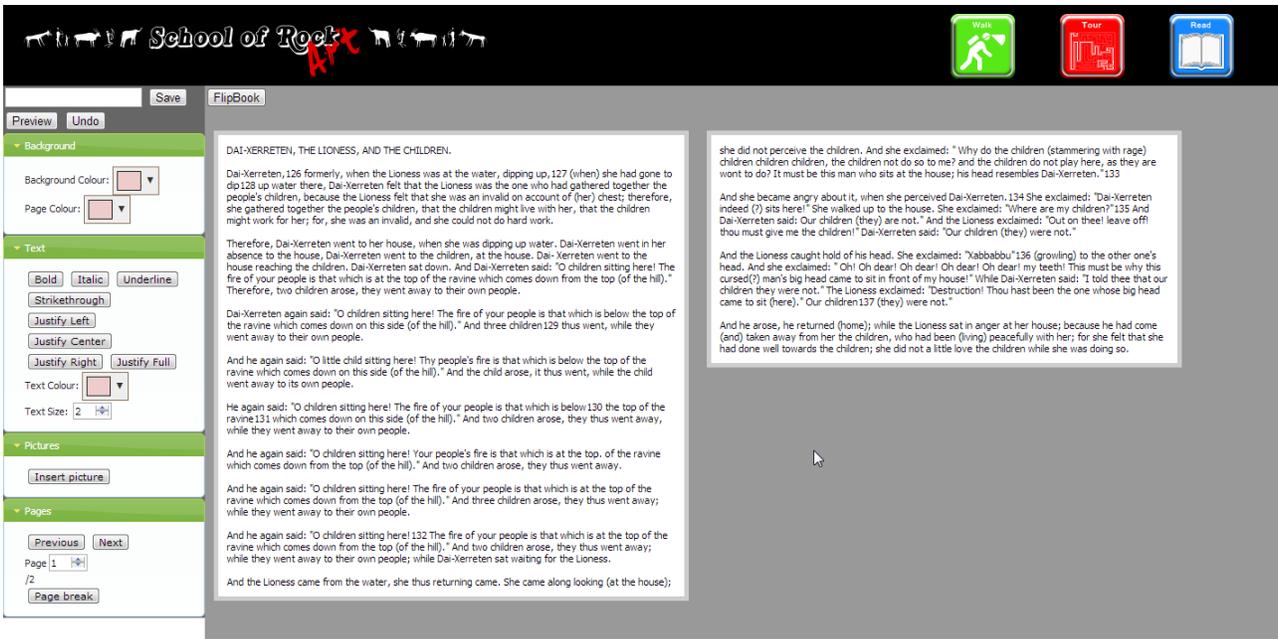
Figure 3.2: Iteration 2: Design mode

In design mode (shown in Figure 3.2), the side menu was used to house all of the editing options for the story. These options included basic text styling, the insertion of pictures and page breaks, and changing the colours of the area surrounding the book and the pages of the book. For testing purposes, the images available for insertion were taken from a local folder as opposed to from the server. An undo button was implemented so that users would be able to easily recover from mistakes. A preview button was also implemented so that users would be a able to view the book in the flipbook format. An example of the preview feature is shown in Figure 3.3.
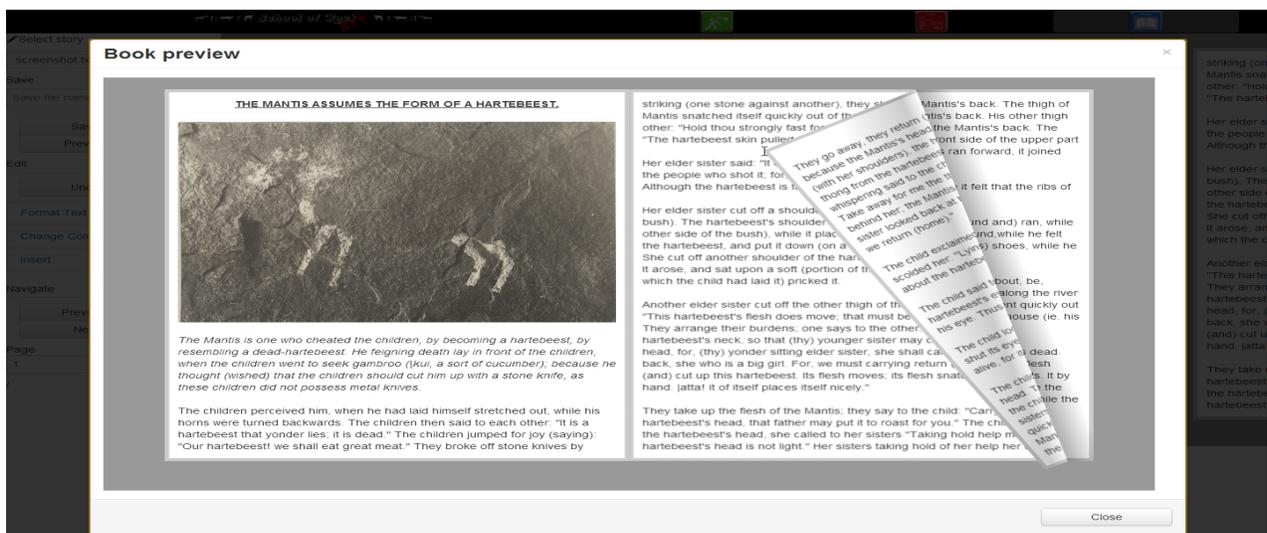
Figure 3.3: Iteration 2: Previewing a book in Design mode

The pages of the story were displayed alongside the side menu. Two pages were shown at a time so that a user could easily compare pages. This is of particular use for designing pages that will be shown alongside each other in the flipbook. Users could navigate through the pages using the navigation controls in the side menu or using the arrows on the keyboard.

Feedback

Quick and dirty user testing was used to gain feedback on the design of iteration 2. This type of testing was chosen as it is quick and easy to perform, but still able to provide useful insight on which to base design decisions (Chisnell 2008). Two students from the Computer Science Honours class and one third year student were asked to review the system. From their comments, the following key points can be summarized:

- Inserted images should be resizeable

- Text should flow around images

- Changing the text colour is not useful

- When changing the font size, the current size of the selected text should be shown

- Editing options should be grouped together under descriptive group names E.g. "Insert" for insert picture and insert page break

- The styling of the site needed to be improved upon in terms of the colours used and the styling of menu items

3.3.3   Iteration 3

Iteration 3 consisted of improving on the current design with regards to the feedback from iteration 2, as well as creating the Home page, the Story Selection page and the About page and linking all of the pages together. Skeleton Home and About pages were created, consisting of only a project menu bar across the top part of the screen and a side navigation panel to navigate among the Home, Story Selection and About pages (Shown in Figure 3.4). The Story Selection page was created in a similar manner, except that it displayed the names of the various stories available for viewing. Each story name was linked to the Story View page with the name passed through as a parameter in the url to determine which story to display.

Figure 3.4: Iteration 3: Skeleton for the Home and About pages

The Story View page was also linked to the Edit page. Users could edit any story by clicking on a small pencil icon located in the side menu. This icon was made small and inconspicuous so that

non-expert users would not accidentally switch to edit mode. Again, the name of the story was passed through as a parameter in the url to determine which story was to be edited. In edit mode, the story being edited could at any time be changed by selecting the desired story from the drop down list in the side menu.

With regards to the feedback from iteration 2, some changes were made. The editing options were organised into groups in the side panel. Text styling was put under "Format Text", changing the background and page colours under "Change colours" and inserting images and pagebreaks under "Insert". The ability to change the text colour was removed, as to was the ability to change the font size as it caused problems with the editor.
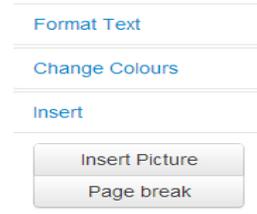
Figure 3.5: Iteration 3: Edit menu (Insert tab expanded)

With regards to resizing images, it was found that in Webkit browsers there is a bug that does not allow images to be resized when contenteditable is turned on (Bugzilla 2011) (Bugzilla 2012). Allowing text to flow around an image also presents a problem. It is easy enough to achieve using the CSS float property if the position of an image is fixed. However, an image can be moved around in the text and positioned to the left, right or center. At present there is no simple way of solving this problem. In the future, however, CSS exclusions, which define arbitrary areas around which inline content can flow (W3C 2012a), will offer a trivial solution to this problem. A decision was thus made for now to make all images a default size (Shown in Figure 3.6) and defer resizing the images, and wrapping text around images, to future work.

Figure 3.6: Iteration 3: All images in a story have a default size of 450px x 200px

The styling of the site was improved using Bootstrap. Buttons and links were styled, as too was the display of pages in both the View and Design story modes. The navigation menu in the side panel was styled to show the current section. The same was done for the top menu to display which part of the project is currently being viewed.

Feedback

An evaluation of this iteration can be found in the Evaluation Chapter (Chapter 4).

3.4 Final Design

The final design of the system can be broken down into the different sections described below. Figure 3.7 gives an overview the system. The gray links represent links between pages.
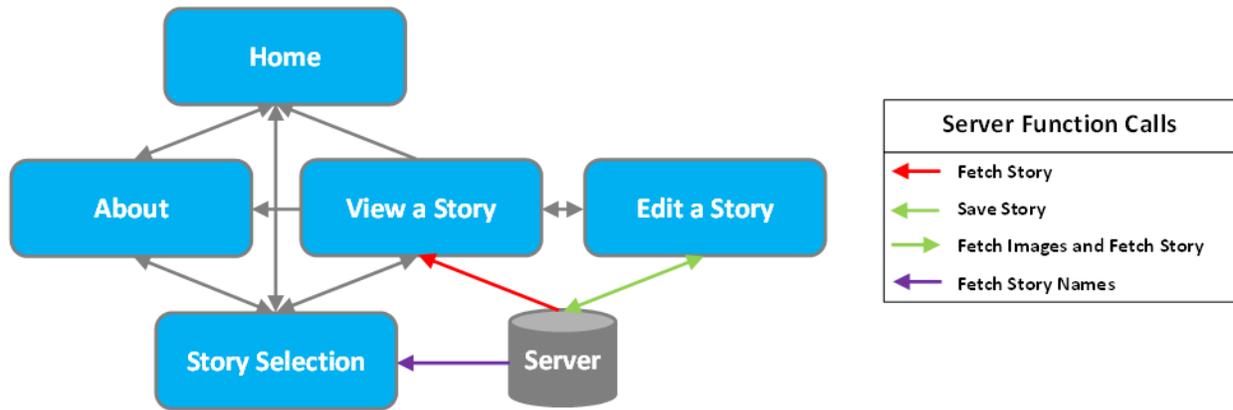
Figure 3.7: Overview of the storytelling system design

3.4.1 Interface

The interface consists of five pages, all with a common theme of a top menu bar to navigate among the different group member projects. All of the pages, excluding the Edit a Story page, also share a navigation panel on the left side of the screen. The different pages are:

1. Home page

   The Home page consists of a welcome message and links to the Story Selection page and the About page.
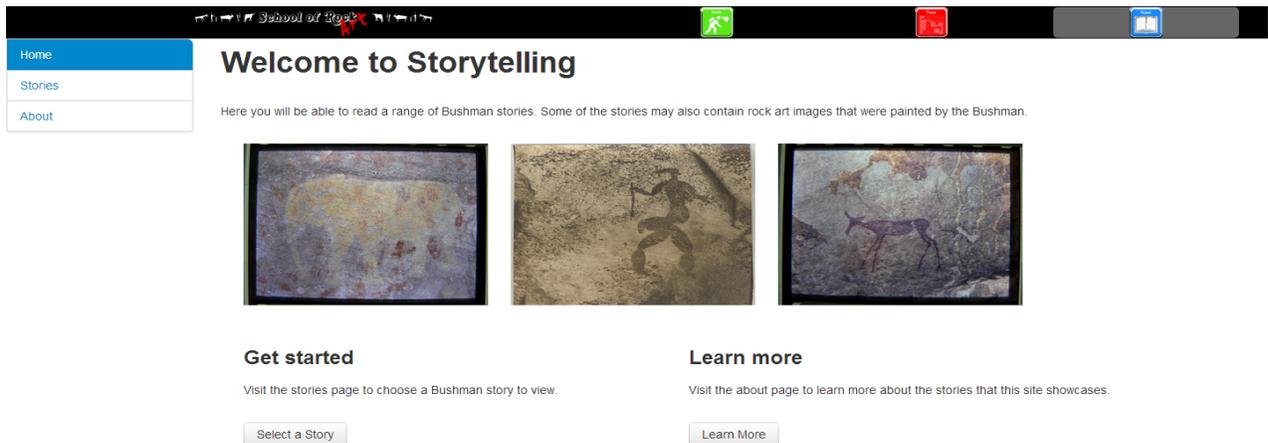
Figure 3.8: Final Design: Home page

2. Story Selection page

The story selection page shows a list of the various stories that can be viewed.
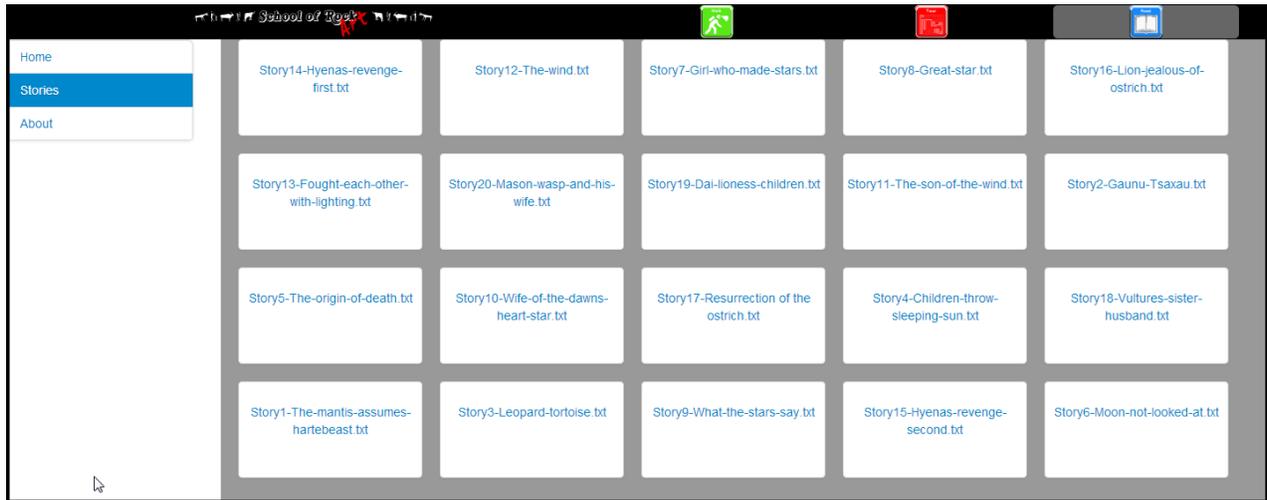
Figure 3.9: Final Design: Story Selection page

3. Story View page

This page displays a story that has been selected from the Story selection page. The story is displayed in a flipbook format. It can be navigated with the arrow keys on the keyboard, by clicking the corner of a page or dragging a corner of the book.
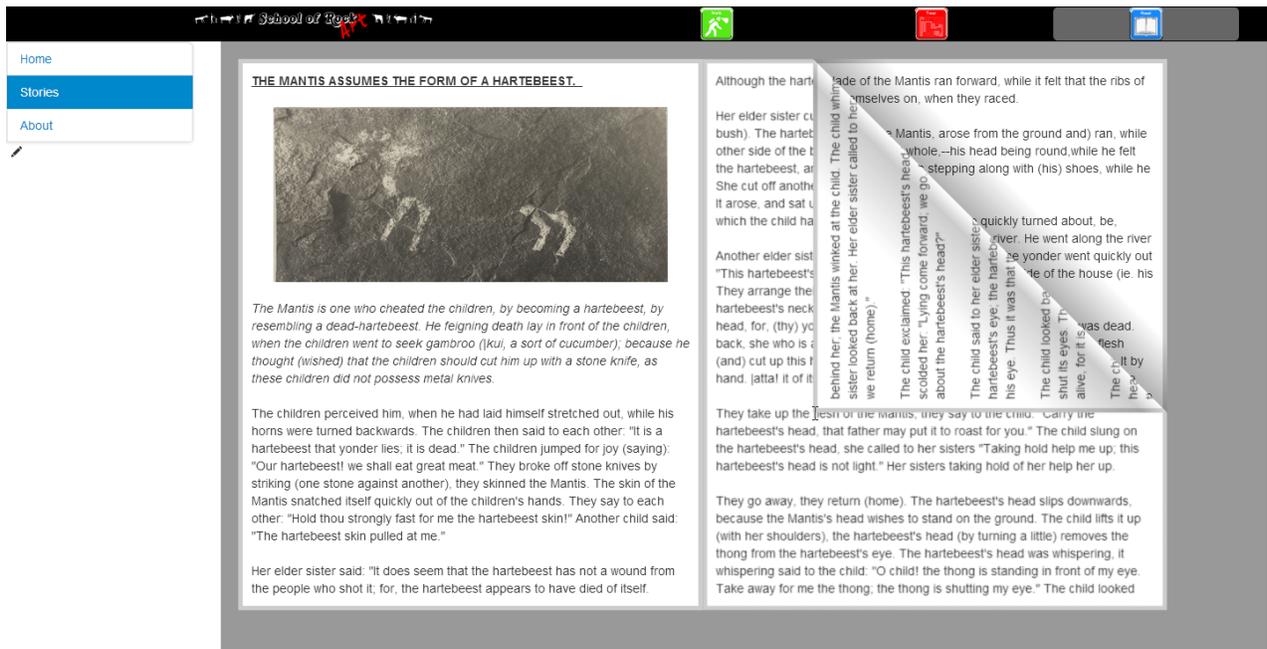
Figure 3.10: Final Design: View a Story page

4. Edit a Story page
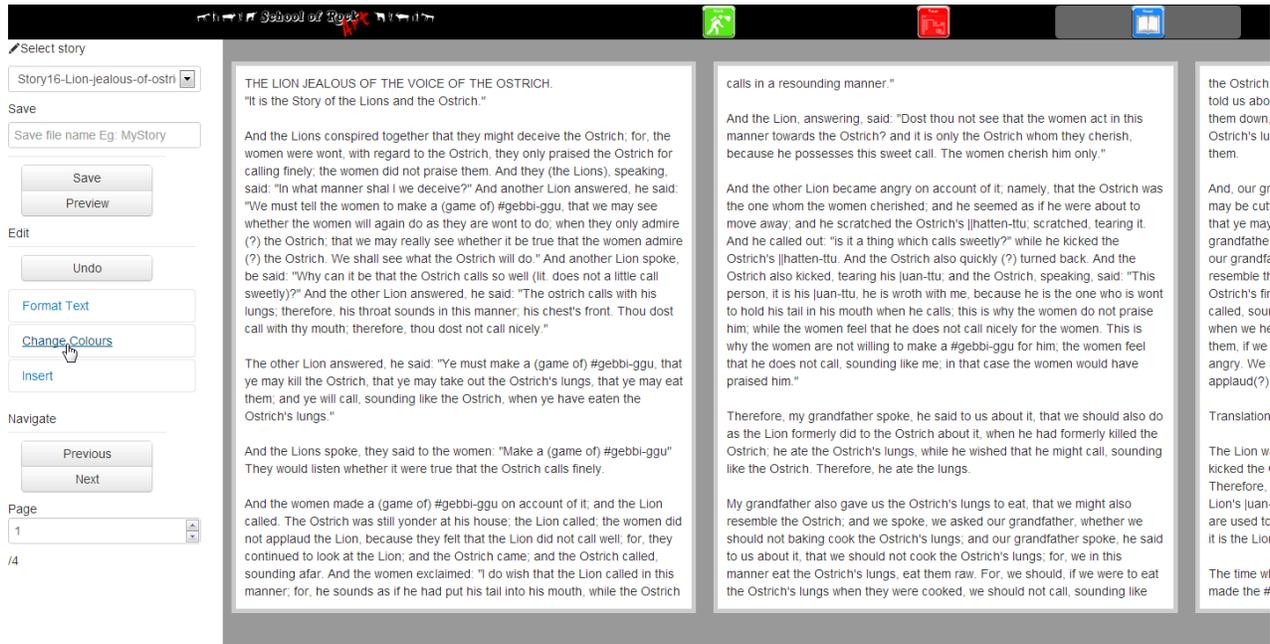
Figure 3.11: Final Design: Design mode

This page provides a Design mode and allows the user to customise a story. Controls are available in the left side panel of the screen and allow the user to perform a variety of editor options. Users can select the story they would like to edit from the side menu. They can then save the story with a custom name.

Text in the story can be formatted by highlighting the text and then clicking on one of the formatting options under "Format text" in the side panel. These options include making text:

- Bold
- Italic
- Underlined
- Strikethrough
- Justify Left, Right, Centre or Full

The background and page colours of the book display can also be set under the "Change Colours" option in the side panel. Pictures and Page Breaks can also be inserted into the story by placing the cursor in the text at the insertion position, clicking on "Insert" on the side panel and clicking either Picture or Page Break. Choosing to insert a picture will bring up a dialog where a picture can be chosen for insertion (See Figure 3.12). Choosing to insert a Page Break will insert "————Page-Break————" into the text to signify the break. To remove the page break, this can simply be removed from the text.
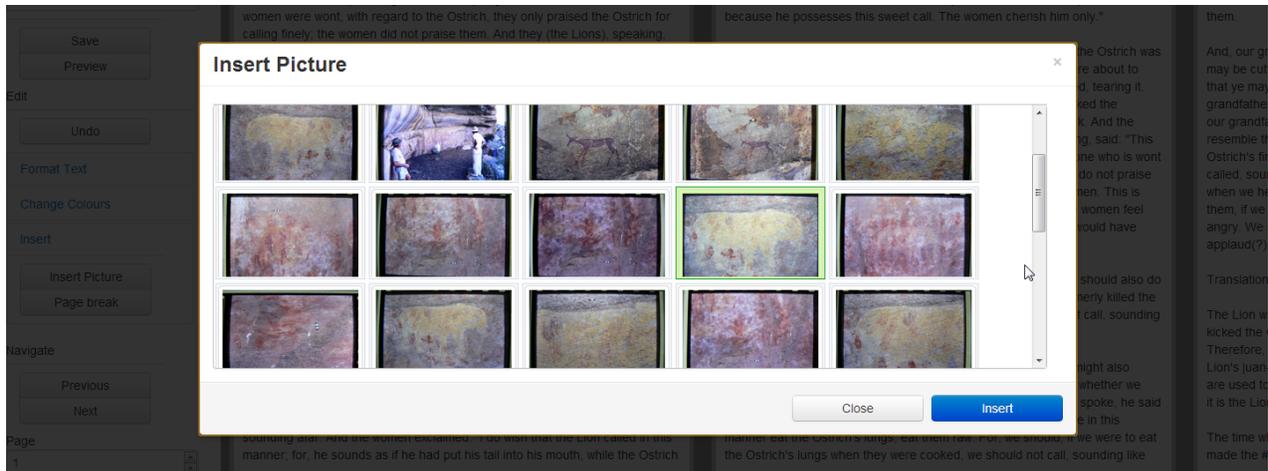
Figure 3.12: Final Design: Dialog for choosing an image for insertion into a story

Pictures available for insertion will depend on the content of the story. A search is performed whereby the terms antelope, rhebuck, eland, hartebeest, elephant, zebra, bird, ostrich, sheep, feline or cat, wildebeest, buffalo and rhino are searched for in the text. If any of these words are found in the text then the metadata files on the server are searched to determine whether any rockart of these animals was found at a site. If there were occurrences at a particular site, then all images from the site are displayed for image selection. A more ideal solution for locating images would have been to identify the terms that have the highest frequency in the text and then search for related images. This was unfortunately not possible due to the nature of the data.

The story itself is displayed on the right of the screen in page format. A user can navigate to the different pages using either the arrow keys or the controls in the side menu. Text on each page can be removed or added to at the liberty of the user. This is made possible by each page being a contenteditable DIV. The text will flow from one page to the next if it exceeds the current page. Likewise, if the text on a page has space for more, the text from the next page will move to that page, unless of course there is a page break defined. The algorithm that is used to decide on whether the text should move from one page to another is detailed in the following section and is called if there is overflow on a page (text needs to move to the next page) or if the height of the text on the current page reduces (text may need to be moved from the next page to the current page).

5. About page

This page details where the stories used on the site are sourced from, namely from the book "Specimens of Bushman Folklore" by W. H. I. Bleek and L. C. Lloyd.. It also provides a brief background of the Bleek and Lloyd collection.
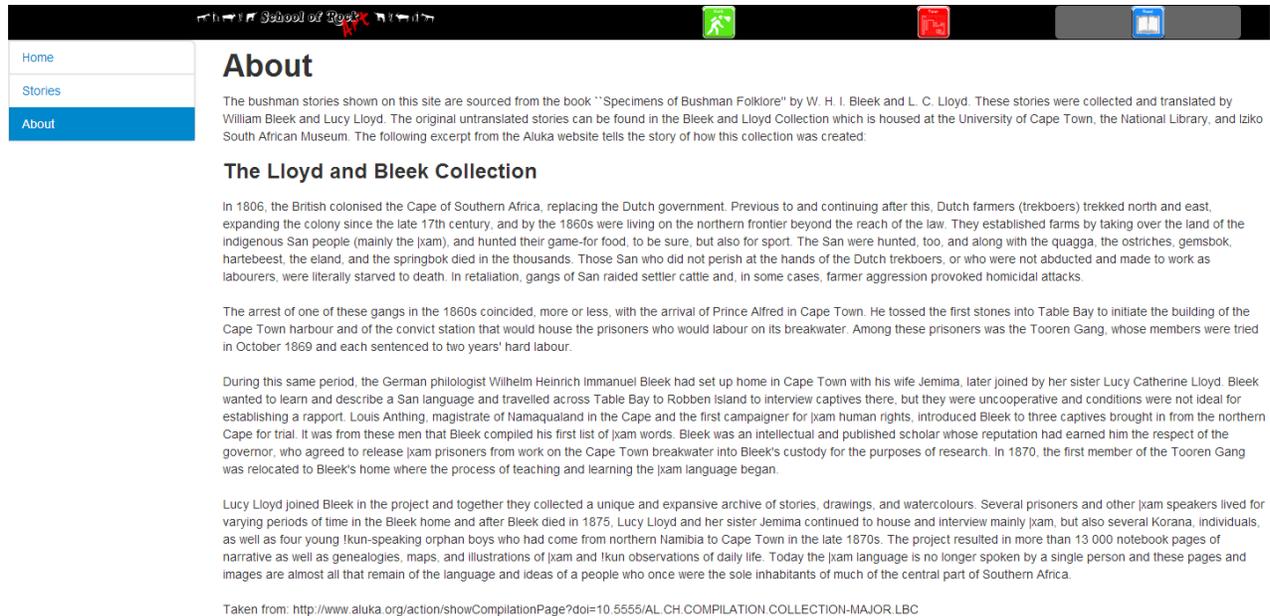
Figure 3.13: Final Design: About page

3.4.2 Text Flow Algorithm

There is no way of redirecting the overflow of one DIV element to another in HTML, therefore a heuristic algorithm was needed. The algorithm used is an adaptation of the first-fit algorithm for solving the bin packing problem. The first-fit algorithm attempts, for each item, to place the item in the first bin that can accommodate the item. If no bin is found, a new bin is created and the item is placed within the new bin. The adapted algorithm is as follows:

```
function pagebreak()
{
    Get all the text (including any html formatting)
    Separate this into individual words and html elements and place these into an array

    Create a temporary DIV with the same dimensions as a page

    For each of the elements from the above array
        Place the element into the temporary DIV
        If the element is a page break then
            Copy what is currently in the temporary DIV and place it into a new page
            Empty the temporary DIV
        If the element has caused overflow in the temporary DIV then
```

Copy what is currently in the temporary DIV except for the last element and place it into a new page

Empty the temporary DIV

Place the last element back into the temporary DIV

Copy what is left in the temporary DIV and place it into a new page

Remove the temporary DIV

}

3.4.3 File Structure

The original story files are stored in a folder named "raw". These files are simple text files containing the words of the story with the heading on the first line, followed by a series of paragraphs. These stories were taken from the book "Specimens of Bushman Folklore" by W. H. I. Bleek and L. C. Lloyd (1911).

Stories that are edited in design mode and then saved are stored in a folder named "created". One of the reasons for this is to ensure that the original files are never accidentally overwritten. Another reason is that, when an edited story is saved, it is saved with all of its HTML formatting included. The different folders thus provide an easy way to distinguish whether the file can simply be loaded straight into the HTML, or whether it first needs to be split into pages via the page layout algorithm.

3.4.4 Back-end

There are four different functions that take place on the server. These are as follows:

1. Fetch story names

   This function fetches the names of the stories available for viewing.

2. Fetch story

   This function returns the contents of a selected story for viewing or editing. If the selected story file is a raw file then the contents are returned with ⟨br⟩ tags inserted to preserve paragraphs. Created file contents are returned as is as they will already include HTML formatting.

3. Fetch images

   This function returns a set of relevant images for the "Insert a picture"" feature of Design mode. It takes in a set of tag names to read. It then searches through all of the folders of the archaeological data for metadata files and reads the values of these tags in each file. If a tag has a value greater than zero, the folder containing the metadata file as well as any sub-folders are searched for jpeg files. The file paths of these images are then returned.

4. Save story

   This function saves a story that has been edited in Design mode. The file will be saved on the server in the created folder under the name provided in Design mode.

3.4.5 School of Rock Art Home page

The School of Rock Art Home page provides an introduction to the project and provides links to the different parts of the project, namely cave navigation, guided tours and storytelling (Shown in Figure 3.14). A heading was designed for the project with an African font used to create the rock art figures on either side of the name. A brief introduction to the site is also provided. The link to the cave navigation part of the site was displayed with an image of a man exploring a cave and the keyword "Walk" to refer to walking through and exploring a cave. The guided tours link was given an image of a maze with a path defined through it and the keyword "Tour" to refer to going on a guided path. The link to the storytelling feature was shown as an open book with the keyword "Read" to refer to reading through the various Bushman stories.
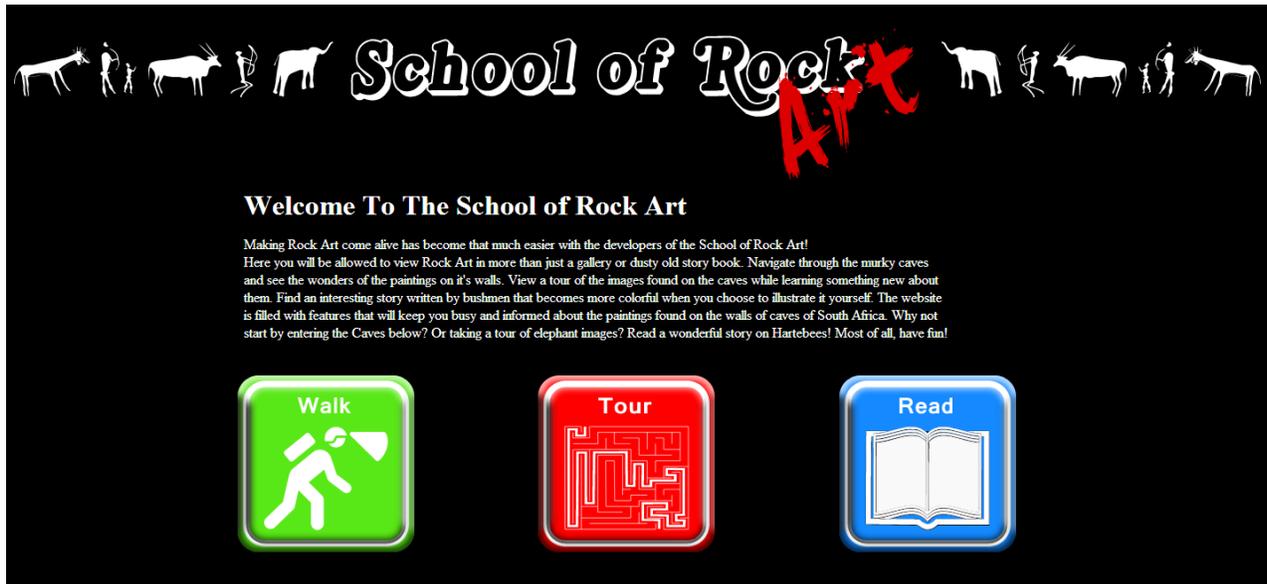
Figure 3.14: Final Design: School of Rock Art Home Page

3.5 Summary

This chapter has discussed the design of the system. The iterative design process used has been described, including how each iteration built upon the previous iteration. The system has been described in its entirety, including the tools used to create it and the different components that it is composed of.

Chapter 4

Evaluation

This chapter discusses the evaluation of the system. User testing was used as the evaluation technique. The chapter is broken up into three parts. Section 4.1 describes the methodology used to evaluate the system, Section 4.2 presents the results of the evaluation and Section 4.3 provides a discussion of the results.

4.1 Method

4.1.1 Experimental Design

User testing consisted of each participant testing the three parts of The School of Rock Art project, namely Guided Tours, Storytelling and Cave Exploration, in that order. At the start of the experiment, one of the experimenters gave each participant a brief overview of the project and the system that had been built. Each participant was then informed of the procedure of the experiment (See section 4.1.2 below) before starting the experiment.

4.1.2 Procedure

The following describes the procedure followed by each participant. Participants were seated in front of a computer and given a brief overview of the project and the system that they would be evaluating. They were then shown the questionnaire, which included a consent form on the first page, followed on the next page by a few general demographic questions (See Appendix A). Participants were asked to read over the consent form as well as informed verbally that none of their personal information would be used or tied back to their responses. Once they had given consent and filled in the general information, the experiment began.

Participants were asked to review each of the three parts of the School of Rock Art project. For each part, participants were given a task list to complete. For the Storytelling section there were two main tasks, each consisting of a number of subtasks. These were "View a story" and "Edit a story". These tasks were designed to showcase each part of the Storytelling section. An overview of each task is as follows:

- View a story

  This task allowed users to view a story in flipbook format. A user first selected a particular story from the Story Selection page. They were then able to view the story and read

25

through its contents. The story was displayed in a book format and the user could navigate through the pages using either the arrow keys on the keyboard or by clicking or dragging the corners of the book. The intention of this task was to assess whether users could easily navigate through the system to the desired story, as well as to determine what they thought of the flipbook display.

- Edit a story

  This task involved switching to Design mode and editing a story. Users were told to first change to Design mode by clicking on the small pencil in the side menu. They were advised verbally that the pencil was small and inconspicuous to help prevent non-expert users from accidentally switching to a different mode and becoming confused. They were then asked to change the story being edited and then perform various editing options, such as inserting an image, inserting and removing a page break, and changing the background colour of the book. Users were also asked to preview their changes using the preview button. To conclude, users were asked to save their work and switch back to Viewing mode where they would be able to view their completed product. The intention of this task was to determine if each of the editor options was initiative, easy to use and functioned correctly.

A detailed list of these tasks as given to each participant can be found in the questionnaire in Appendix A.

While participants were performing these tasks, they were observed without interference. They could, however, ask any questions if they did not understand something or got stuck. After completion of the tasks for a section the user was asked to complete a questionnaire relating to that section. Upon completion of all three sections the participant was thanked for their participation and paid. The entire process took, on average, about 45 minutes to an hour to complete.

4.1.3 Questionnaire

A questionnaire was used as one of the methods of evaluation. The questionnaire consisted of a series of 5-point Likert rating scales ranging from "Strongly Agree" on one end to "Strongly Disagree" on the other with "Neither Agree nor Disagree" in the middle. Likert Scales were used as they have the advantage of allowing for degrees of opinion as opposed to a simple yes/no answer (McLeod 2008). This provides quantitative data that can be analysed easily.

The questions used were drawn from well-known questionnaires, including the USE Questionnaire (Lund 2001) and the System Usability Scale (SUS) (Schneider 2011). Custom questions concerning the navigational controls of the site were also added. Similarly to the USE questionnaire, questions were grouped under the headings of Usefulness, Ease of Use and Satisfaction. Open ended questions to assess the features of the system completed the questionnaire. A copy of this questionnaire can be found in Appendix A.

4.1.4 Participants

According to Nielsen (2006), when collecting usability metrics, a sample size of 20 users offers a reasonably tight confidence level. For the evaluation of this study, 24 participants were recruited via posters and email. The only requirement for users was that they needed to have basic computer literacy skills, in particular knowledge of how to use a Web browser. Each participant received R30

for completing the evaluation. All of the participants were students at the University of Cape Town studying towards undergraduate degrees in Humanities, Science, Engineering and Commerce. The average year of study was 2.2 years (Standard Deviation 0.93), with the age range of participants being estimated as being between 18 and 25 years. There were 14 males and 10 females in the participant group. The factors of age, race or gender were not balanced as they were not felt to be relevant to this study.

4.1.5   Materials and Settings

The experiment took place in the Macintosh lab located on the top floor of the Computer Science building. This room was chosen as it was quiet and secluded from the general hustle and bustle of the building. It also had the facilities of five computers that could be used for testing purposes. The Chrome Web browser was used.

4.1.6   Bias and Control Procedures

As with all types of surveys, bias may occur. The types of bias that may affect the results of this evaluation, as well as the controls that have been used to help prevent bias are as follows:

- Central Tendency Bias

  Central Tendency Bias is one of the potential weaknesses of using Likert scales (Bertram n.d.). This type of bias refers to the tendency for participants not to give an extreme answer, unless they hold very strong opinions about the topic in question (Gingery 2009a). In order to help control this bias, the shorter 5 point Likert scale was used as opposed to a 7 or 9 point scale.

- Acquiescence and Habituation Bias

  Acquiescence Bias is another form of bias that can occur with Agree-disagree scales. This type of bias occurs when participants passively agree with survey questions (Gingery 2009b). It sometimes occurs due to participants wanting to "please" the experimenter (Bertram n.d.). It can also be related to Habituation bias, which occurs when respondents provide the same answers for survey questions that have the same response options. In an effort to control these forms of bias, some of the questions included in the questionnaire were phrased in a positive way, while others were phrased in a negative way (Gingery 2009b). Some of the questions appeared in both a positive and negative way so that they could be correlated. This means that, ideally, a positive answer to the positive form of the question should correspond to a negative answer for the negative form of the question. The results from the evaluation did show an indication of this. The offer of anonymity with regards to answering the questionnaire should further aid in reducing any bias.

Another aspect of the testing that may affect the results is that the number of users evaluating the system at any given time ranged from one to three. Users could have been affected by the questions that other users asked during a session. An effort was made to control this by ensuring that each participant evaluated the system on their own and that any questions that were asked and answered were done so as quietly as possible.

4.2   Results

The aim of this evaluation was to measure the usability of the system. According to the ISO 9241-11 standard, usability refers to the extent to which a product can be used by users to achieve certain

goals effectively, efficiently and in a satisfactory manner in a specified context of use (ISO 1998). This definition can be expanded upon to include five attributes: effectiveness, efficiency, user satisfaction, error frequency and severity, and learnability (Scholtz 2004)(Quesenbery 2001)(US Department of Health & Human Services 2012). Of these attributes, satisfaction, error frequency and severity and learnability were evaluated for this system. The results of the evaluation for the Story Telling part of the project with regards to these attributes are discussed below. For a full summary of the results from the questionnaire please refer to Appendix B.

4.2.1 Satisfaction

Satisfaction refers to how pleasant and satisfying a system is to use (Quesenbery 2001). Questions evaluating this attribute were grouped under a heading of the same name in the questionnaire given to participants. The overall result in this section was positive. When asked whether the system was pleasant to use, 18 out of the 24 participants answered positively (15 Agreed and 3 Strongly Agreed). Similarly, when asked whether the system was fun to use, 19 participants answered positively (11 Agreed and 8 Strongly Agreed). These questions can be correlated with the negatively phrased question that asked whether a user found the system to be boring. 18 participants disagreed with this statement (12 Disagreed and 6 Strongly Disagreed), thus showing a clear correlation with the previously-mentioned positively-phrased questions. Participants also felt that the system was wonderful and that they enjoyed using the interface of the system.

A review of the answers for the open ended question "Any other comments?" shows further satisfaction with comments such as:

- I enjoyed the system

- It was very user friendly

- Its very interesting

4.2.2 Error frequency and severity

In all systems, the number of errors that occur should be minimal, and it should be easy to recover from any errors that do occur. While observing participants interacting with the system, as well as from the comments in the questionnaire, there were a few errors that occurred with the system. There were occasional problems with the navigation controls in Design mode. One user pointed out that, although the arrow keys of the spin box for selecting a page worked correctly, the functionality broke if a number that was greater then the total number of pages in the book was entered. The navigation controls were also labelled under the heading "Navigation"; some users felt that this should have had a more descriptive title such as "Change page". There were also no navigation controls in the side menu when viewing a story. This caused confusion for users as they did not know how to change pages.

There were also errors with the saving function. There was no indication after clicking the save button that the save had been made. This caused some confusion for users. One user saved a story with a name that included forward slashes. As this name is used as the file name for saving the story, the slashes caused an error to occur. Some users also saved their edited stories with a name that was similar to that of the original. This caused confusion for users who evaluated the system afterwards as they were not sure which story to edit.

Minor errors also sometimes occurred when inserting images and page breaks. These items were occasionally inserted in the incorrect places or caused the calculation of the different pages to be slightly incorrect.

Overall, however, most users felt that they could recover from mistakes quickly and easily. Users also felt, on average, that they did not notice any inconsistencies when using the system and agreed that the various functions of the system were well-integrated.

4.2.3 Learnability

An interface that is easy to understand and learn to use allows users to build on their knowledge without deliberate effort (Quesenbery 2001). Participants were asked whether they felt that they needed to learn a lot of things before they could start using the system. 17 users disagreed with this statement (12 Disagreed and 5 strongly Disagreed). 14 users also said that they would not need the help of a technical person to use the system. In fact, most users said that they thought the system was easy to use and that they felt very confident using it. This is positive when considering that participants, on average, spent only 15 minutes using the system. All of the participants also felt that they could navigate through the system easily. The controls of the system were also felt to be easy to use and intuitive.

Improvements could, however, be made to the system. When asked whether they could use the system without written instructions, although 13 felt that they could, 7 participants disagreed. 5 users also felt that the system was unnecessarily complex and some users commented that they were not sure how to perform certain actions, such as removing a page break in Edit mode. This could most likely be improved upon by adding help functionality to the site to explain the controls.

4.2.4 Additional results

The open ended questions in the questionnaire provided additional insight. Users liked the flipbook effect as well as the ability to edit a story. Most users felt that there were no features that were not useful, while some commented that they did not like the small pencil icon that is used to switch to Design mode. This icon was intended to be small and inconspicuous so that non-expert users would not accidentally switch to Design mode. By the comments with regard to this icon's size the design seems to achieve this purpose. One participant did comment that although it was difficult to get to design mode, it made sense as they would ordinarily not have the need to do so.

During the evaluation some participants also showed an interest in the content of the stories and the rock art itself. A couple of users took the time to read through an entire story, while a number of users scrolled through all of the rock art images available for insertion in order to choose the one they most liked. One participant also asked about the way in which the stories are written and if, with reference to the repetition and language used, that was indeed the way the Bushman wrote/spoke.

Users also gave some suggestions for additional features that they felt should be a part of the system. These included:

- The ability to print a book

- The ability to download a book

- More control over the insertion of images

- A help section to explain how to use the different editor options E.g. How to insert a page break

4.3   Discussion

From the above results, it can be concluded that, overall, users were very satisfied with the Storytelling component. Users in particular enjoyed the animation effects of the flipbook. There were also positive reviews for the ability to edit a story, with most people enjoying being able to insert images. The aim of the Storytelling component was to allow users to view stories in an enjoyable manner and to additionally allow users to edit and design storybooks so that they would be even more enjoyable to read. From these results, it can be said that the system has come very close to fulfilling these aims.

As seen from the Error results, improvements could be made to the system. More feedback, for instance, could be given to users after performing certain actions, such as saving a story in Design mode. Features such as the navigation could also be improved on. Errors in the system were generally minor, though, and thus did not have a major affect on the usability of the system.

In terms of learnability, users did not seem to have too much trouble learning how to use the system. Some users in design mode did have problems with how to insert images or page breaks. This was mainly due to the fact that the cursor needs to be placed in the text before inserting an item. This could be improved upon by having the cursor permanently positioned in the text, or by providing an error message before insertion that the cursor needs to be placed in the text. The first option may be preferential as this is similar to the way most word-processing programs work and thus would most likely be familiar to users. A help feature could also be added, in particular for Design mode to explain the different editor options.

The results thus show that the system is easy to use and enjoyable. It exhibits the desired attributes of User Satisfaction, Errors at a low enough rate that it does not significantly affect usability, and Learnability. Improvements could be made to further reduce errors in the system and to add additional features to the system.

Furthermore, the results show an interest by participants in rock art and Bushman stories after viewing the system. More evaluations would need to be conducted to determine the level of interest, as well as the factors affecting users interest in these subjects. The result is, however, positive in terms of the system's aim to encourage users to learn more about rock art. As the system exhibits learnability, the system could easily be used by teachers to create enjoyable Bushman stories to teach to learners. Learners could also be given an opportunity to create their own stories or customize existing stories.

Chapter 5

Conclusion

The aim of this project was to create a system to showcase rock art and to encourage people to learn more about rock art. The School of Rock Art website was created for this purpose. The site is a compelling website that allows a user to learn more about rock art by allowing users to navigate through 3D caves containing rock art, experience guided tours of rock art and read Bushman stories that are illustrated with rock art images. The storytelling feature of the site was discussed in this report. This feature allows users to also edit existing stories, or create new ones, with a focus on adding related rock art images to the story to enhance it visually.

The research question for the storytelling feature asked, "Is it possible to build an engaging and dynamic storytelling environment to encourage learning about rock-art?" From the evaluation results, it was shown that the storytelling feature interested users, and was both easy to use and enjoyable. Furthermore, it could easily be used in an educational environment to encourage learning about rock art. It can therefore be concluded that it is possible to build such an environment.

The research question should, however, also mention encouraging learning about Bushman and their traditional stories. The system that was created blends together both the rock art images that can be used in stories, as well as the stories themselves. Both of these items enhance and add to each other. The stories provide a narrative of Bushman heritage, beliefs and culture, while the rock art images provide the visual.

Chapter 6

Future Work

There are a number of possibilities for future work for this project in order to improve aspects such as end-user satisfaction, performance of the system, and security of the system. Some of these possibilities are discussed below.

6.1 Login

Currently there is no verification of stories that have been created or edited by users. This is problematic if users submit content that is malicious or offensive. One way of combating this would be to create a login facility and only allow registered users to edit stories. In this way, a user who saves content that is unsatisfactory could we warned and ultimately banned if necessary. A login feature would also mean that the ability to switch to Design mode could be made available only once a user has logged in. A first time user of the site would have no way of accidentally switching to Design mode and becoming confused.

6.2 Improve data quality

In Design mode the rock art images that are available for insertion are determined by whether the words antelope, rhebuck, eland, hartebeest, elephant, zebra, bird, ostrich, sheep, feline or cat, wildebeest, buffalo or rhino appear in the text of a story. If one of these words are found in the text, then all of the images from a site that is said to contain rock art of that animal will be available for insertion. A site will generally contain a range of images though, not only images of the given animal. Some of these images may be completely unrelated to a story, such as site recording forms, graphs of the layout of a site and notes scribbled by site recorders. With the current metadata there is, however, no way of distinguishing the contents of an image. Future work could thus include identifying the contents of each image and storing this in either a database or metadata files. One way of identifying the contents would be to use folksonomy. Folksonomy is a method whereby content is annotated and categorized collaboratively by the consumers of the content. The value in this stems from consumers using their own vocabulary and adding explicit meaning, which can often only come from an inferred understanding of the content (Wal 2007). User tags would allow a much wider range of keywords to be searched for and should produce more accurate results.

6.3 Workspace and integration between parts

A Workspace was one of the features suggested by the client. The Workspace would be a panel that would slide out and allow users to record information. Users would, for example, be able to write down their thoughts, drag content from the page into the workspace and so on. This feature was meant to be present over the different sections of the School of Rock Art site so that users would be able to easily keep a record of a range of information. Unfortunately, due to time constraints, this feature was not implemented in the current project. It would be a very useful feature to add to future implementations and would aid in integrating the different parts of the School of Rock Art site. Further integration could be provided by displaying a tour icon with each image that is available for insertion and also part of a tour in the Guided Tour part of the project. Images that are part of a cave that is available to view through the cave exploration part of the project would also be shown with a cave icon to represent this link.

6.4 Improve Saving of stories

At present, when a story is saved, there is no feedback given to users that the story has been saved. The name entered to save the story as, is also not validated to ensure that it does not already exist, or that it does not contain any characters that cannot be used in a file name. This feature could thus be improved to include such validation and to provide feedback in terms of a success message, or an error message with the cause of the error shown. Upon exiting design mode the user could also be prompted to save or discard any changes made.

6.5 Improve Image insertion

In Design mode all inserted images will have a default size and cannot be resized. This is mainly due to a bug with Webkit browsers that does not allow images to be resized when the contenteditable property is true. Once this bug is fixed, support could be added to resize inserted images. Alternatively, the system could be edited to support additional browsers that do allow for image resizing, such as Mozilla Firefox. There were also problems with allowing text to flow around inserted images. With the upcoming CSS exclusions module (W3C 2012a) this functionality should be easy to implement and add to the system. The ability to select an image from one's own computer for insertion could also be added.

6.6 Additional Story and Editor Features

Additional options could be added to the system. Some of the users in the evaluation suggested adding options to either print or download a story. The various options for editing a story could also be added to, such as being able to change the font of a story, or allowing text to be highlighted. The ability to add other types of media would also be useful. For example, using HTML5, video and audio elements could easily be added to enhance a story. A help panel could also be added describing the various editor options.

6.7 Additional information in stories

The stories used in this project are taken from the book "Specimens of Bushman Folklore" by W. H. I. Bleek and L. C. Lloyd. Many of these stories contain reference numbers in the text that provide

additional information. For example, in the story "The Great Star, !Gaunu, which, Singing, Named The Stars.", one of the references is:

> The stars ||Xwahai ||aiti and ||Xwhai-@pua were identified as "Altair" or "Alpha Aquilae", and "Gamma Aquilae", respectively, by the late Mr. George Maclear and Mr. Finlay of the Royal Observatory, on October 10, 1873, at Mowbray. ||Xwhai gwai was behind a tree and too low to be distinguished.

While this is interesting information, it is not of particular relevance to the story itself. For this reason, and to help improve the flow of the stories, these numbers, as well as their corresponding reference entries, were removed from the text. Many would find this information to be an interesting side note to a story. A feature could be added that would allow a user to insert one of these references into the text of the story or create an additional information page.

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Appendix A

User Evaluation Questionnaire

Only the sections relevant to the storytelling section are shown.

School of Rock Art
User Evaluation Survey

Confidentiality and Privacy

If you consent to participate in this evaluation, your personal information will be kept confidential. Any information you choose to provide will be kept private between you and the researcher.

The record kept of your survey responses does not contain any identifying information about you unless a specific question asks for it. Answering any of the questions is optional, but please answer as many questions as possible to guarantee the validity of the results of the study.

Statement of Consent

"I acknowledge that I have read the above explanation of this evaluation. I understand that the collected data from this survey will be analysed and used to evaluate the mentioned website. I also understand that the researcher will not disclose my personal information. By selecting the option 'Next' below I agree to participate in this evaluation"

There are 25 questions in this survey

About you

1 [1.1] What is your main field of study (Faculty)?

Please write your answer here:

2 [1.2] What academic qualification are you currently registered for?

Please choose **only one** of the following:

- ○ Bachelors
- ○ Honours
- ○ Masters
- ○ PhD
- ○ Other

3 [1.3] What is your year of study of the current degree?

Please choose **only one** of the following:

- ○ First
- ○ Second
- ○ Third
- ○ Fourth
- ○ Fifth
- ○ Other

Story Telling

Please complete the tasks below and then return to answer the questions:

Task 1
1. View the home page
2. Navigate to the Story list
3. Select "The mantis assumes the form of a Hartebeest" story to read
4. View the story

Task 2
1. Switch to design mode
2. Change the story that you are editing to "The Lion jealous of the Voice of the Ostrich"
3. Select the heading and make it bold and underlined
4. Select the sub-heading and make it italic
5. Change the background colour to blue
6. Insert a picture after the heading
7. Insert a page break after the picture
8. Delete the page break
9. Navigate through the pages using the side controls or the arrow keys
10. Preview the story
11. Save the story
12. Switch back to view mode

11 [3.1] Usability

Please choose the appropriate response for each item:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I thought the website was easy to use	○	○	○	○	○
I found the website unnecessarily complex	○	○	○	○	○
I think that I would need the support of a technical person to be able to use this website	○	○	○	○	○
I found the various functions in this website were well integrated	○	○	○	○	○
I needed to learn a lot of things before I could get going with this website	○	○	○	○	○
I felt very confident using the system	○	○	○	○	○

12 [3.2] Ease of use

Please choose the appropriate response for each item:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
It is usable	○	○	○	○	○
I can use it without written instructions	○	○	○	○	○
I don't notice any inconsistencies as I use it	○	○	○	○	○
I can recover from mistakes quickly and easily	○	○	○	○	○
I can navigate through the site easily	○	○	○	○	○
The controls were easy to use	○	○	○	○	○
The controls were intuitive	○	○	○	○	○

13 [3.3] Satisfaction

Please choose the appropriate response for each item:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
It is fun to use	○	○	○	○	○
I like using the interface of this system	○	○	○	○	○
I found the system boring	○	○	○	○	○
I would suggest this to my friends	○	○	○	○	○
I want to spend more time using it	○	○	○	○	○
It is wonderful	○	○	○	○	○
I feel I need to have it	○	○	○	○	○
It is pleasant to use	○	○	○	○	○

14 [3.4] In your opinion, which feature(s) was the most useful?

Please write your answer here:

15 [3.5] In your opinion, which features(s) was the least useful?

Please write your answer here:

16 [3.6] What features do you think could be improved on or added?

Please write your answer here:

17 [3.7] Any other comments?

Please write your answer here:

Thank you very much for completing this survey and for helping us with our project.
Please remember to collect your remuneration from us.

Please submit by 24.10.2012 – 00:00

Submit your survey.
Thank you for completing this survey.

Appendix B

User Evaluation Results

Only the results from the storytelling section are shown.

Usability

I thought the website was easy to use

Answer	Count	Percentage
Strongly Agree (A1)	7	29.17%
Agree (A2)	11	45.83%
Neutral (A3)	1	4.17%
Disagree (A4)	4	16.67%
Strongly Disagree (A5)	0	0.00%
No answer	1	4.17%

I found the website unnecessarily complex

Answer	Count	Percentage
Strongly Agree (A1)	0	0.00%
Agree (A2)	5	20.83%
Neutral (A3)	4	16.67%
Disagree (A4)	9	37.50%
Strongly Disagree (A5)	6	25.00%
No answer	0	0.00%

I think that I would need the support of a technical person to be able to use this website

Answer	Count	Percentage
Strongly Agree (A1)	0	0.00%
Agree (A2)	5	20.83%
Neutral (A3)	5	20.83%
Disagree (A4)	10	41.67%
Strongly Disagree (A5)	4	16.67%
No answer	0	0.00%

I found the various functions in this website were well integrated

Answer	Count	Percentage
Strongly Agree (A1)	4	16.67%
Agree (A2)	14	58.33%
Neutral (A3)	3	12.50%
Disagree (A4)	3	12.50%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

I needed to learn a lot of things before I could get going with this website

Answer	Count	Percentage
Strongly Agree (A1)	0	0.00%
Agree (A2)	6	25.00%
Neutral (A3)	1	4.17%
Disagree (A4)	12	50.00%
Strongly Disagree (A5)	5	20.83%
No answer	0	0.00%

I felt very confident using the system

Answer	Count	Percentage
Strongly Agree (A1)	7	29.17%
Agree (A2)	12	50.00%
Neutral (A3)	2	8.33%
Disagree (A4)	3	12.50%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

Ease of Use

It is usable

Answer	Count	Percentage
Strongly Agree (A1)	10	41.67%
Agree (A2)	13	54.17%
Neutral (A3)	0	0.00%
Disagree (A4)	1	4.17%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

I can use it without written instructions

Answer	Count	Percentage
Strongly Agree (A1)	6	25.00%
Agree (A2)	7	29.17%
Neutral (A3)	4	16.67%
Disagree (A4)	6	25.00%
Strongly Disagree (A5)	1	4.17%
No answer	0	0.00%

I don't notice any inconsistencies as I use it

Answer	Count	Percentage
Strongly Agree (A1)	5	20.83%
Agree (A2)	6	25.00%
Neutral (A3)	8	33.33%
Disagree (A4)	4	16.67%
Strongly Disagree (A5)	1	4.17%
No answer	0	0.00%

I can recover from mistakes quickly and easily

Answer	Count	Percentage
Strongly Agree (A1)	6	25.00%
Agree (A2)	10	41.67%
Neutral (A3)	4	16.67%
Disagree (A4)	3	12.50%
Strongly Disagree (A5)	0	0.00%
No answer	1	4.17%

I can navigate through the site easily

Answer	Count	Percentage
Strongly Agree (A1)	9	37.50%
Agree (A2)	11	45.83%
Neutral (A3)	4	16.67%
Disagree (A4)	0	0.00%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

The controls were easy to use

Answer	Count	Percentage
Strongly Agree (A1)	9	37.50%
Agree (A2)	11	45.83%
Neutral (A3)	2	8.33%
Disagree (A4)	1	4.17%
Strongly Disagree (A5)	1	4.17%
No answer	0	0.00%

The controls were intuitive

Answer	Count	Percentage
Strongly Agree (A1)	8	33.33%
Agree (A2)	9	37.50%
Neutral (A3)	4	16.67%
Disagree (A4)	2	8.33%
Strongly Disagree (A5)	1	4.17%
No answer	0	0.00%

Satisfaction

It is fun to use

Answer	Count	Percentage
Strongly Agree (A1)	8	33.33%
Agree (A2)	11	45.83%
Neutral (A3)	4	16.67%
Disagree (A4)	1	4.17%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

I like using the interface of this system

Answer	Count	Percentage
Strongly Agree (A1)	4	16.67%
Agree (A2)	12	50.00%
Neutral (A3)	6	25.00%
Disagree (A4)	2	8.33%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

I found the system boring

Answer	Count	Percentage
Strongly Agree (A1)	0	0.00%
Agree (A2)	2	8.33%
Neutral (A3)	4	16.67%
Disagree (A4)	12	50.00%
Strongly Disagree (A5)	6	25.00%
No answer	0	0.00%

I would suggest this to my friends

Answer	Count	Percentage
Strongly Agree (A1)	4	16.67%
Agree (A2)	9	37.50%
Neutral (A3)	10	41.67%
Disagree (A4)	1	4.17%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%

I want to spend more time using it

Answer	Count	Percentage
Strongly Agree (A1)	2	8.33%
Agree (A2)	8	33.33%
Neutral (A3)	11	45.83%
Disagree (A4)	2	8.33%
Strongly Disagree (A5)	1	4.17%
No answer	0	0.00%

It is wonderful

Answer	Count	Percentage
Strongly Agree (A1)	2	8.33%
Agree (A2)	13	54.17%
Neutral (A3)	6	25.00%
Disagree (A4)	0	0.00%
Strongly Disagree (A5)	3	12.50%
No answer	0	0.00%

I feel I need to have it

Answer	Count	Percentage
Strongly Agree (A1)	3	12.50%
Agree (A2)	6	25.00%
Neutral (A3)	8	33.33%
Disagree (A4)	4	16.67%
Strongly Disagree (A5)	3	12.50%
No answer	0	0.00%

It is pleasant to use

Answer	Count	Percentage
Strongly Agree (A1)	3	12.50%
Agree (A2)	15	62.50%
Neutral (A3)	5	20.83%
Disagree (A4)	1	4.17%
Strongly Disagree (A5)	0	0.00%
No answer	0	0.00%