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Virtual Museum for NACHA

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DEPARTMENT OF COMPUTER ENGINEERING**

Date: June 13, 2018

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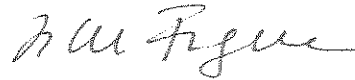
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Alisa Hawthorne**

ENTITLED

Virtual Museum for NACHA

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND ENGINEERING



Thesis Advisor



Department Chair

Virtual Museum for NACHA

by

Sonali Chaudhry
Alisa Hawthorne

Submitted in partial fulfillment of the requirements
for the degree of
Bachelor of Science in Computer Science and Engineering
School of Engineering
Santa Clara University

Santa Clara, California
June 13, 2018

Virtual Museum for NACHA

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ABSTRACT

Our team worked with the Nso' Arts and Cultural Heritage Association and created a virtual museum in order to increase awareness of the unique culture of the Nso' people in Cameroon, Africa. A lot of information from this region is in danger of being lost due to political tension and poor artifact conservation, and many people, including the Cameroonian youth, are not prioritizing the preservation of their culture and history. Creating a website where individuals can view the art, history, and culture found in Cameroon is the best way to increase the availability of knowledge of the Nso' people. Such a system will not only allow individuals to become more familiar with Cameroon, but it will also allow researchers to update the site and add new information as they go deeper into their research. Since anyone with a web-enabled device will be able to access the virtual museum, it has the potential to get people from around the world, including the youth in Cameroon, interested in learning more about the art, history, and traditions native to that region.

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Chapter 1

Introduction

1.1 Motivation

In today's world, most people would agree that information is readily available online. Despite how accessible information is today, there are pockets of missing knowledge from numerous cultures around the world. A lot of such knowledge is in danger of being lost due to political tension and poor artifact conservation. Furthermore, in many countries, much of this cultural knowledge is passed on through oral tradition, rituals, and performances. Sadly, the prevalence of smartphones and other forms of entertainment all over the world mean that today's youth are not as interested in learning about the culture and traditions that are being passed on to them, and when they finally are interested, it is often too late because the elders who would have taught them have already passed away. This means a lot of cultural knowledge is dying with community elders. [1]

One such community where cultural knowledge is in danger of being lost is the Nso' Fondom (Kingdom), which can be found in Cameroon, Africa (Figure 1.1). Although general information about the culture can be found on websites such as Wikipedia and bfu-usa.org they don't properly showcase the culture and traditions of Cameroon. Thus, as of now, the only way to really get access to the Nso' culture is to visit the Fondom or talk to someone who is familiar with the culture. Due to the lack of accessibility to this culture, the unique history and legacy of this region is in danger of being lost or destroyed.

1.2 Solution

Currently, the Nso' Arts and Cultural Heritage Association (NACHA) has a database containing images and descriptions of more than 300 items native to the Nso' people in Cameroon. We created a virtual museum for NACHA in order to increase awareness of this region. Our project not only allows individuals to become more familiar with Cameroon, but it also allows researchers to update the website and add new information as it becomes available. Providing such a system where information can be updated and shared is the best way to make this knowledge available to most people. Since anyone with a web-enabled smartphone can access the virtual museum, it has the potential to reach people all around the world, and to get them more interested in learning more about the art, history, and traditions native to the Nso' Fondom. Drawing awareness to this region is important because it will prevent this culture from dying out and aid in promoting the preservation of their artifacts and history. Moreover, our virtual museum provides a template for future endeavors to preserve and raise appreciation for other cultures in similar positions.



Figure 1.1: Map of Cameroon with the Northwest region highlighted.

Chapter 2

The Problem

2.1 Requirements

Our project meets the following requirements in order to fulfill the usability standards of our virtual museum. Functional requirements indicate what our system needed to do, or in other words, what functionalities it provides to end users. Non-functional requirements specify what our system is or how it needed to behave. Design constraints limited the ways in which our software was designed and implemented.

2.1.1 Functional Requirements

- Required
 - Login and logout
 - Create an account
 - Add and remove users
 - Add, remove, and edit objects
 - Add, remove, and edit exhibitions
 - Edit the home page
 - Browse and search the website
- Suggested
 - Edit website layout
 - Contact NACHA from the site

2.1.2 Non-Functional Requirements

- Website is organized in a clear and intuitive way
- Design highlights the Nso' culture
- Data is stored securely
- Website has a responsive design
- Website is efficient and does not perform unnecessary tasks
- Website is visually attractive

2.1.3 Design Constraints

- Easily accessible through most major web browsers
- Works on both desktop and mobile platforms
- Hosted on AWS

2.2 Use Cases

Figure 2.1 depicts the use cases for our system. Our virtual museum has three actors: the users, who can browse and search the website; administrators (admins), who are able to edit the website's content, invite people to become researchers or admins, and manage accounts; and researchers, who can modify the website's content. More detailed instructions on how to use the website can be found in Appendix A.

1. Login

Goal: To successfully login to the site

Actors involved: Administrators, Researchers

Pre-condition: Have an account

Steps: From the login page, enter correct login credentials and click "Login" button

Post-conditions: Actor is now logged in and can modify the website according to his or her privileges

Exceptions: None

2. Logout

Goal: To successfully logout of the site

Actors involved: Administrators, Researchers

Pre-condition: Have an account and be logged in

Steps: Click the "Logout" button in the right corner of the page

Post-conditions: Actor is now logged out and can no longer modify the website

Exceptions: None

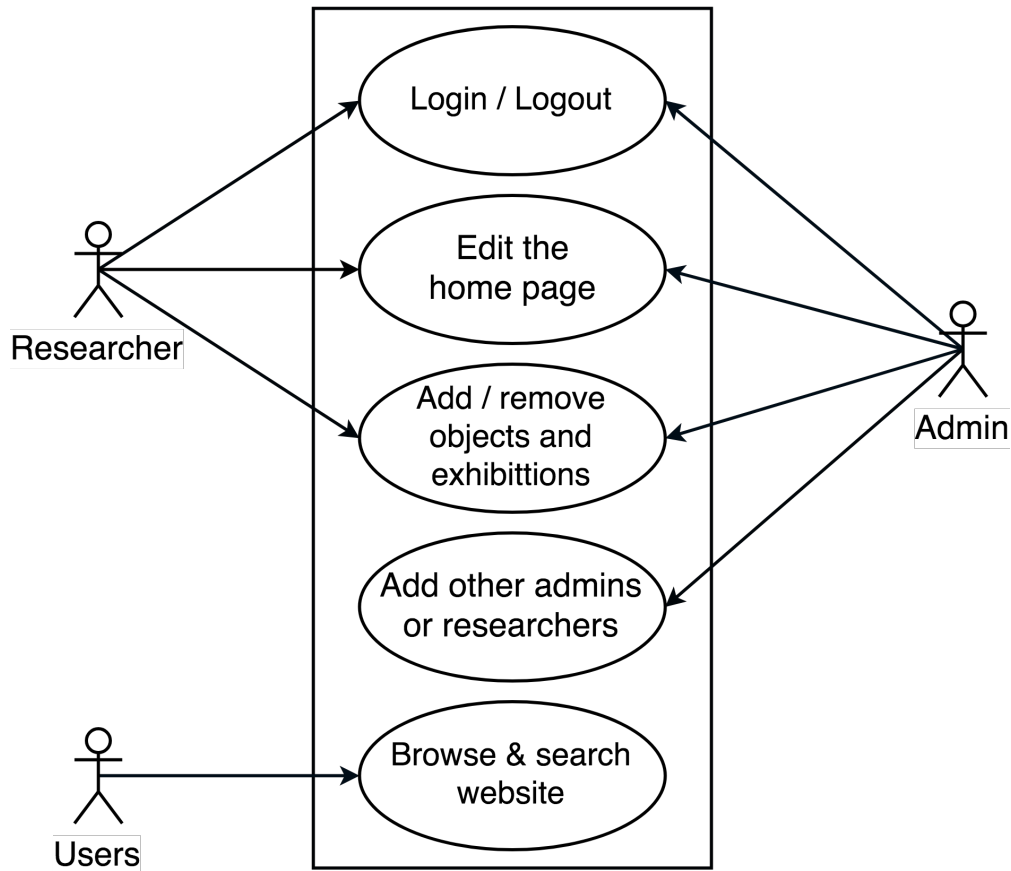


Figure 2.1: Use Cases

3. Edit the home page

Goal: Change the featured images and captions on the home page

Actors involved: Administrators, Researchers

Pre-conditions: Be successfully logged in

Steps: Select the “Edit the Home Page” option, then make the desired changes

Post-conditions: The home page now features the updated images and descriptions

Exceptions: None

4. Add, remove, and edit the website’s content

Goal: To add, remove, or edit objects and exhibitions from the website

Actors involved: Administrators, Researchers

Pre-conditions: Be successfully logged in

Steps: Login, then click either the “Add New Object” or “Add Exhibition” option to add information. Select “Delete Object” or “Delete Exhibition” to remove content from website as needed. To edit an object or exhibition, go to that object or exhibition page and click the “Edit” button to make the desired changes

Post-conditions: The website content has been updated with the specified changes

Exceptions: None

5. Add other admins or researchers

Goal: Invite other people to be administrators or researchers and allow those people to create an account

Actors involved: Administrator

Pre-conditions: Be successfully logged in as an admin

Steps: Select the “Invite User” option; an email will be generated inviting the specified email address to become either an admin or researcher depending on which option was selected

Post-conditions: The invited user can now create an account

Exceptions: None

6. Browse and search website

Goal: View objects and explore virtual exhibits through browsing or searching the site

Actors involved: All Users

Pre-conditions: Access to a web-enabled device

Steps: From the website, click a link in the navigation bar or enter a phrase in the search bar to browse and search the virtual museum

Post-conditions: The user has an enjoyable experience and wants to come back and learn more

Exceptions: None

Chapter 3

The Solution

3.1 Architecture

Figure 3.1 shows the architecture of our system. In order to function as a virtual museum, our website stores a large amount of data and images; therefore it made sense to use a data-centric model. Users access the website, and in response the web server pulls information from the database. Administrators and researchers can also edit the website content through the website itself.

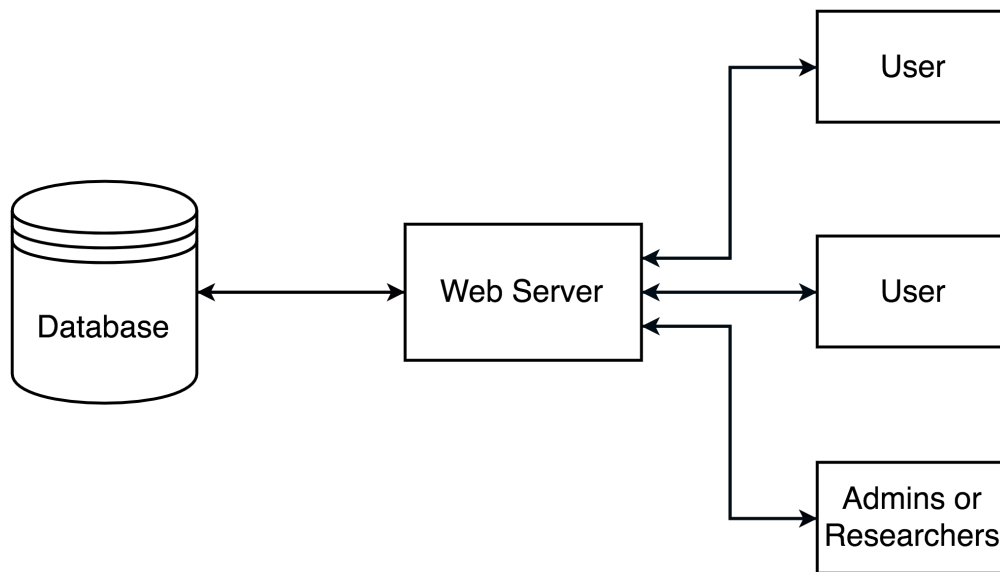


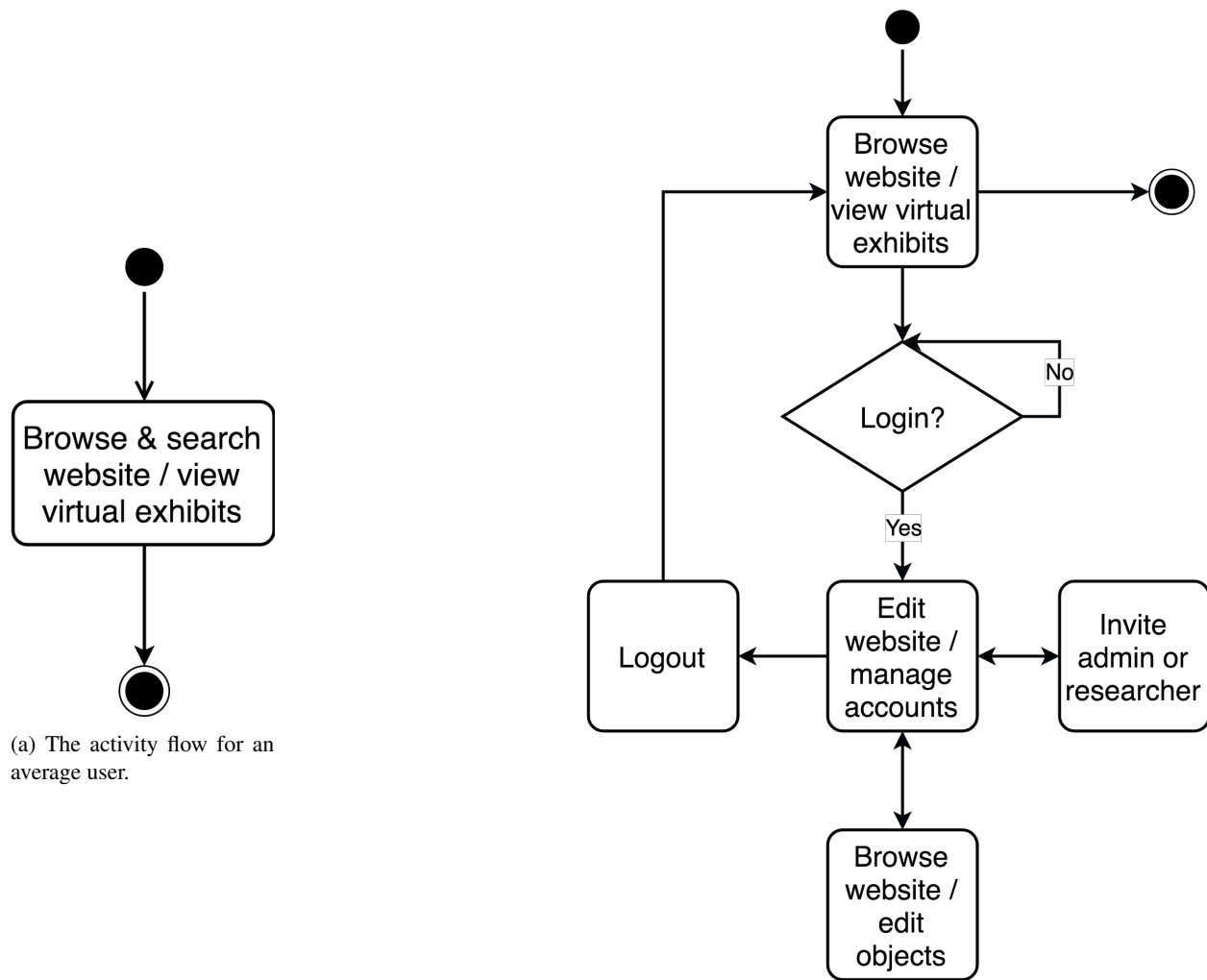
Figure 3.1: Architectural Diagram

3.2 Activity Diagram

Figure 3.2a depicts the general activity flow for an average user. The user starts off on the website home page. From there, they are able to browse and search the site to view virtual exhibits and objects.

Figure 3.2b shows the steps of how an administrator or researcher can use the system. In order to preserve the Nso' artifacts and record accurate data for them, it is necessary for multiple users to be able to login and make changes to the site. We created two different types of accounts in order to do this. The first type will allow researchers to add, remove, and edit objects and exhibits. The second type will give administrators the same access as researchers, but with additional privileges to manage accounts and invite new researchers or administrators. Starting from any page, researchers and admins can browse and search the site like a general user, but they also have the additional option to login. After logging in, the admin/researcher can edit the website content, add or remove objects and exhibits, or logout. Admins can also invite other users to create an account.

Although double ended arrows are not standard in activity diagrams, we use them in Figure 3.2b to simplify the diagram and increase readability.



(a) The activity flow for an average user.

(b) The activity flow for an administrator or researcher.

Figure 3.2: Activity Diagrams

3.3 Technologies Used and Design Rationale

We want our virtual museum to be easily accessible by as many users as possible. Therefore, we created the website using standard web technologies that are supported by most browsers. This will keep things simple for us when maintaining and updating the site, and allow people from all over the world to access our museum regardless of their screen sizes or preferred browsers. The following is a list of technologies used in the development/deployment of our system and why we chose them.

- **HTML and CSS**

HTML is the standard markup language for creating web pages and applications, and CSS is the standard style sheet language for styling the user interface of said web pages and applications. Since our project has a web-based solution, it makes sense that we used HTML and CSS to build and style our website respectively.

- **Javascript (JS)**

Like HTML and CSS, JavaScript is considered a core technology for web development, and is supported by all modern browsers without needing additional plug-ins. Thus, we used JavaScript, and JS libraries such as JQuery, for event handling and to make the site more usable and interactive.

- **PHP**

PHP is a server-side scripting language that was designed primarily for web development, although people also use it as a general purpose programming language. Since PHP can securely handle login sessions and database connections, and is compatible with the AWS servers where our site will be hosted, we used PHP to perform server side tasks such as logging into accounts and pulling information from the database.

- **AWS**

Our data is easily organized into tables, so it makes sense to use a relational, SQL-based database. The Frugal Innovation Hub at Santa Clara University provided us with an AWS account, which allows us to host the website and the SQL database it connects to on the Amazon servers.

- **GitHub**

GitHub is an online Git version control repository hosting service that helped us prevent accidental code loss and ensured that we always had a working version of our project. We chose this tool over other version control technologies because it works well for projects with multiple developers.

3.4 The Design

This section focuses on the final design and layout of our website. Starting on the homepage (Figure 3.3), users can browse the site using the navigation links or use the search bar to find specific objects (Figure 3.4). Users can additionally browser the website through the “Exhibitions” page (Figure 3.5). Clicking on an exhibition will take the user to an exhibit page, which displays a gallery of all objects that belong to that specific exhibit (Figure 3.6). The “Index” page, as shown in Figure 3.7, displays a list of all objects in the system. The “About Us” page, shown in Figure 3.8, gives users more information about NACHA, their goals, and how to contact them.

Researchers and administrators can login to the website (Figure 3.9) after they have created and verified their accounts (Figure 3.10). After logging in, researchers and administrators are taken to their home pages (see Figures 3.11 and 3.12 respectively). From this account page, the logged in user can choose what to do from a variety of actions, such as adding or deleting objects/exhibitions (researchers and administrators), and managing accounts or inviting users (admins only).

The entire website is designed to be responsive. Figures 3.13 and 3.14 highlight two specific instances of this design.

The former image shows what an object page looks like on a mobile device, while the latter image shows how the navigation bar also changes to accommodate smaller screens.



Figure 3.3: The home page of our website.

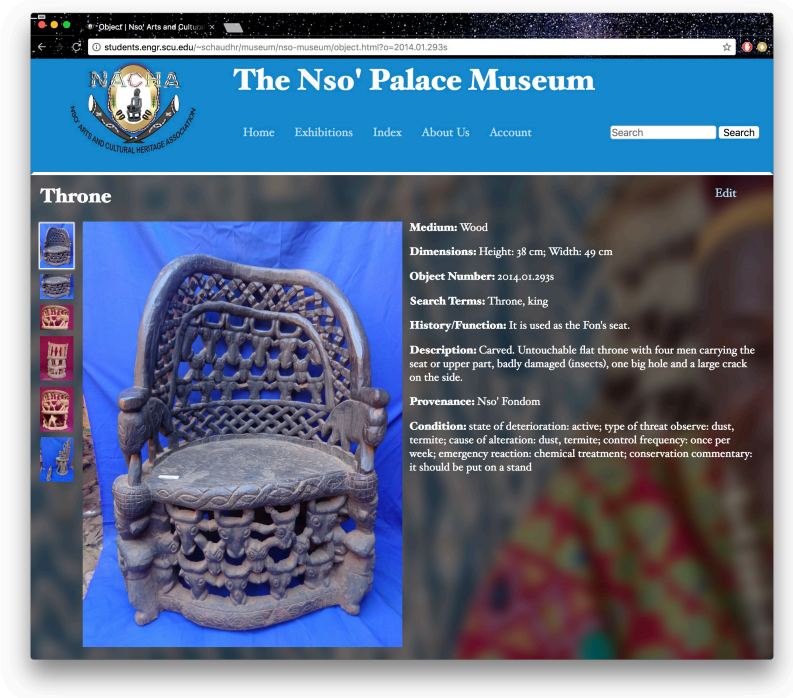


Figure 3.4: An example object page.

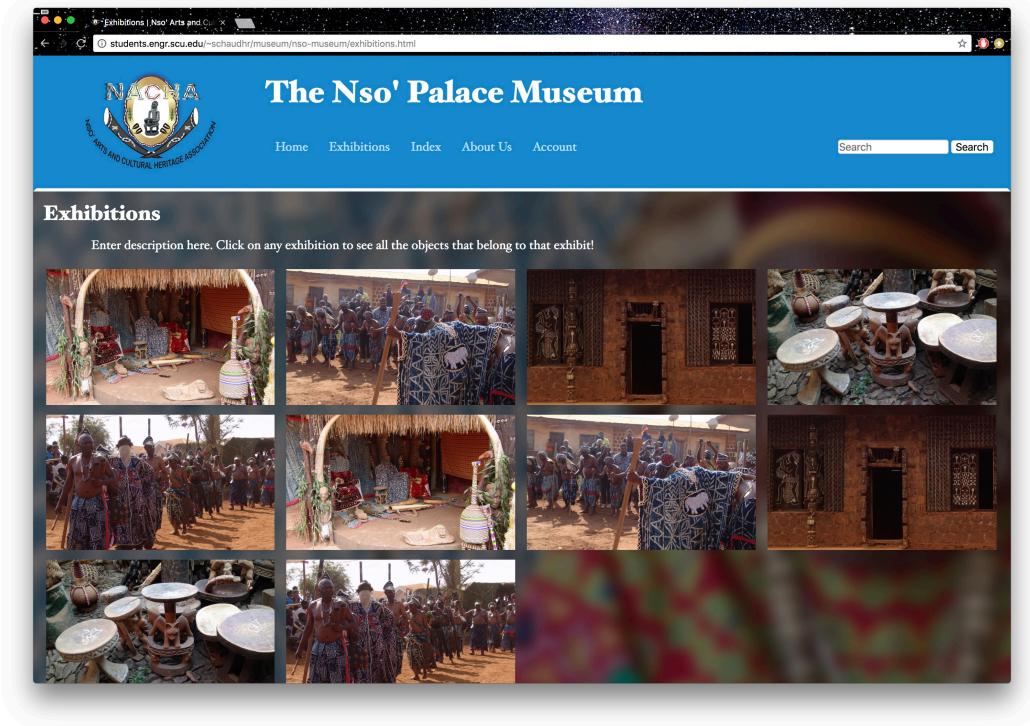


Figure 3.5: The Exhibitions page that shows all the exhibitions in the system.

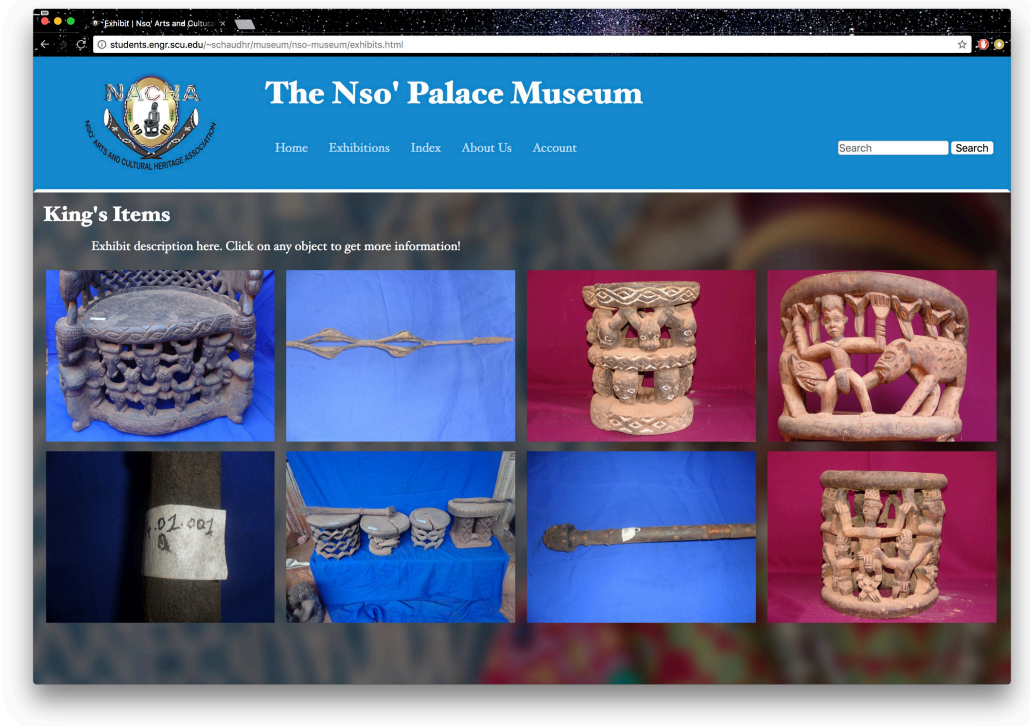


Figure 3.6: An exhibit page that displays all individual objects that belong to a specific exhibition.

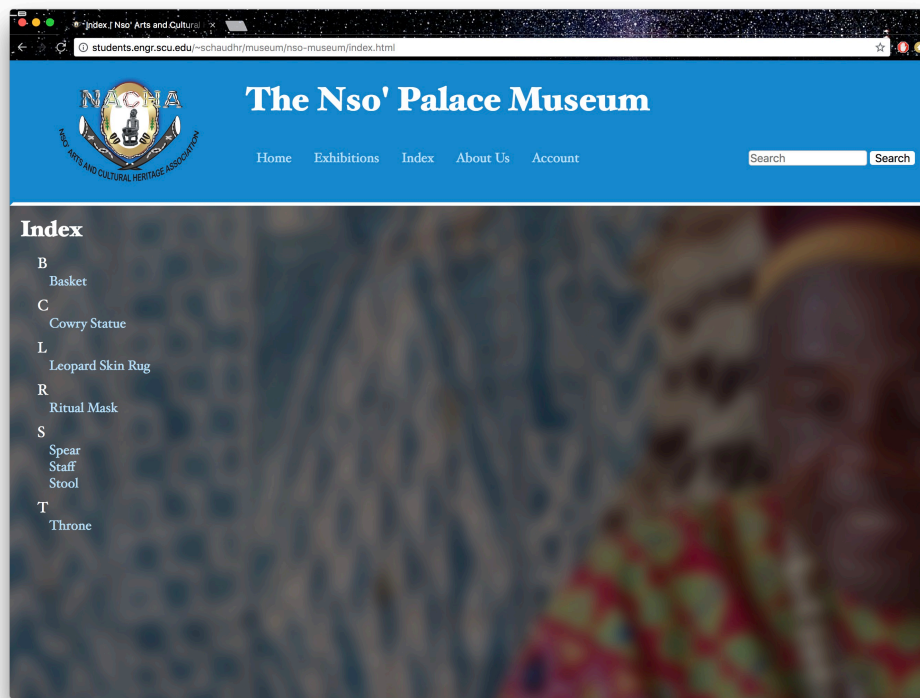


Figure 3.7: The Index page which shows a list of all objects in the system.

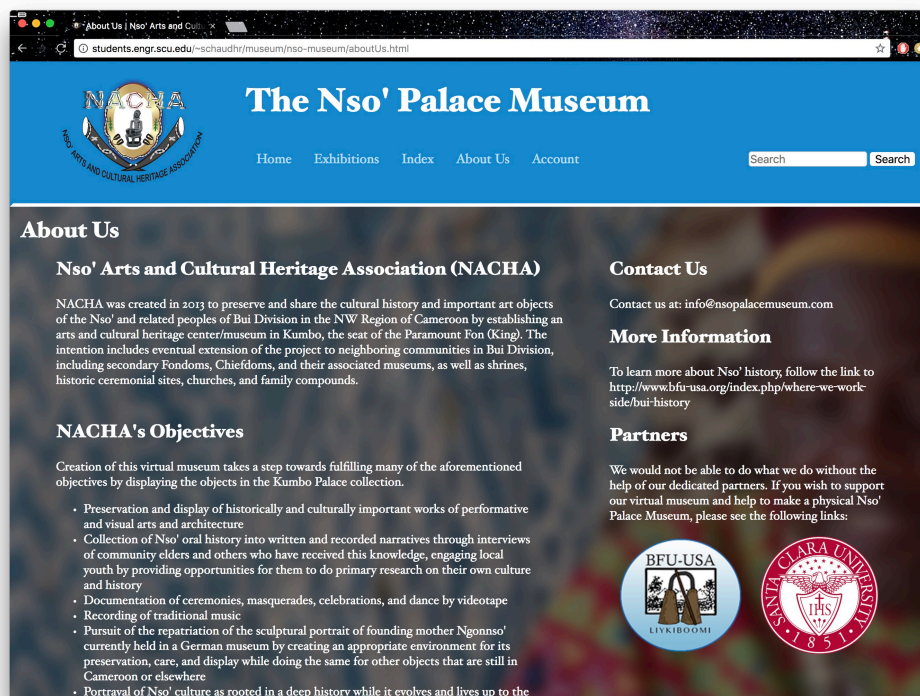


Figure 3.8: The About Us page.

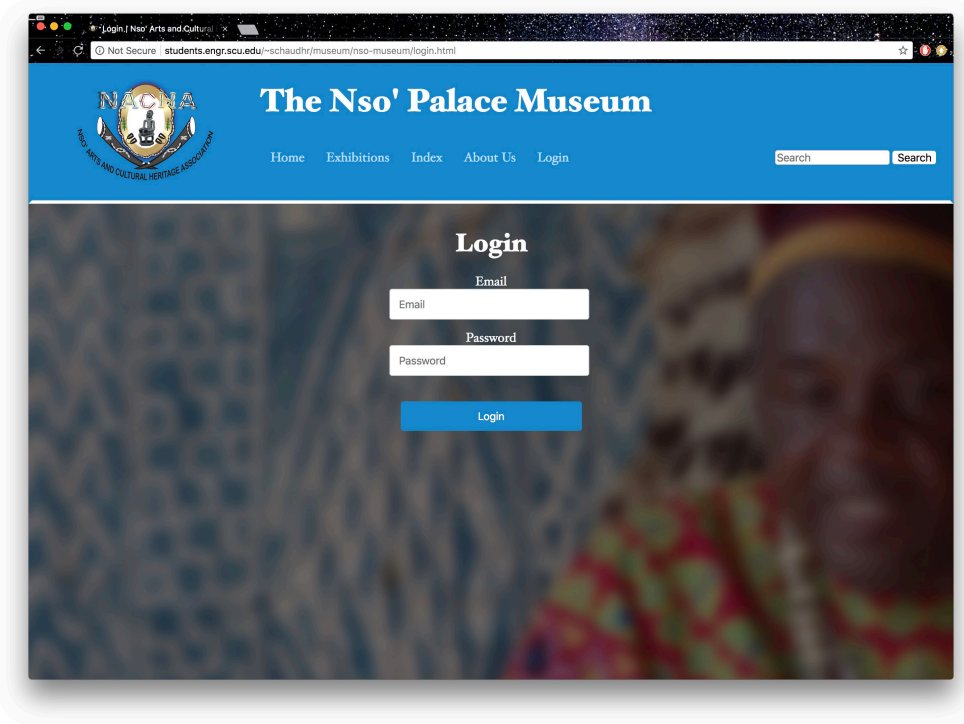


Figure 3.9: The Login page.

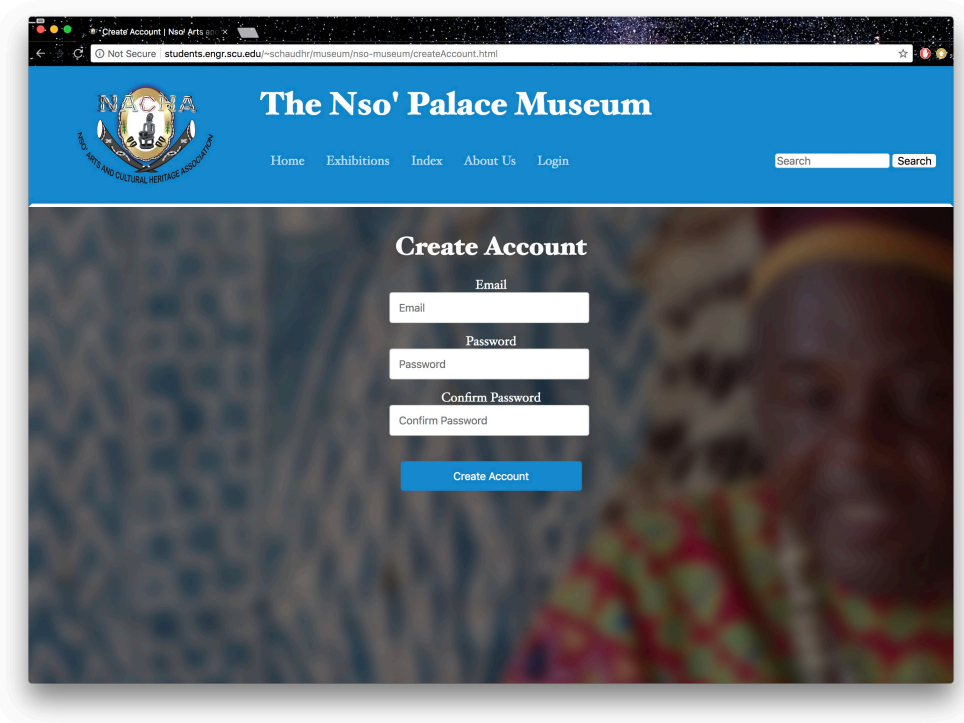


Figure 3.10: The account creation page.

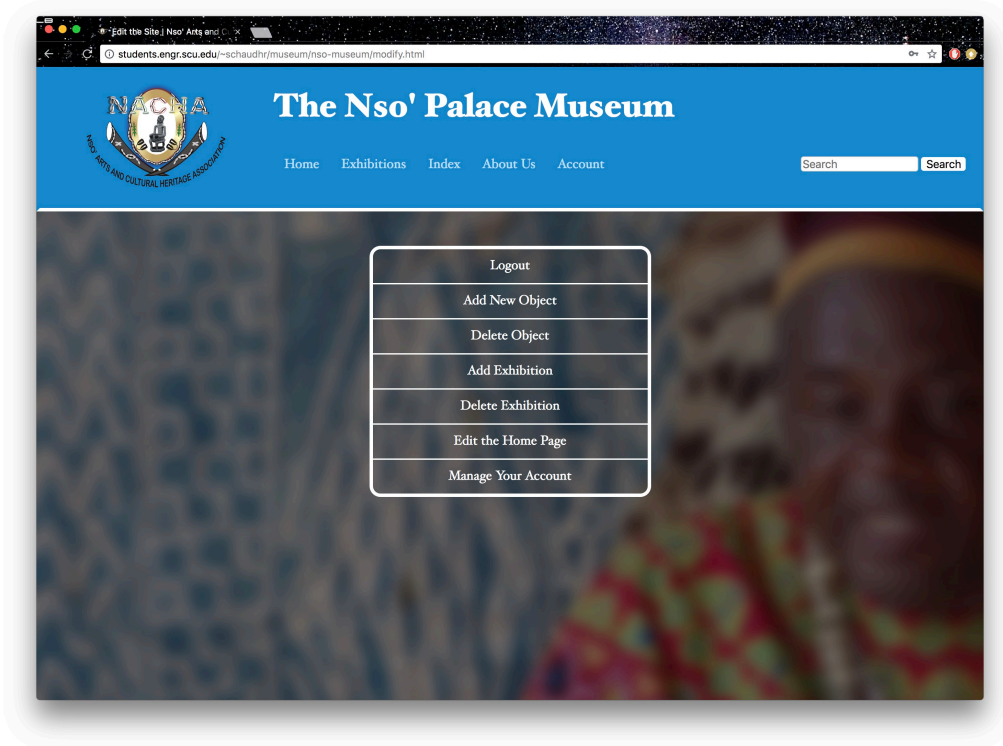


Figure 3.11: The researcher home page.

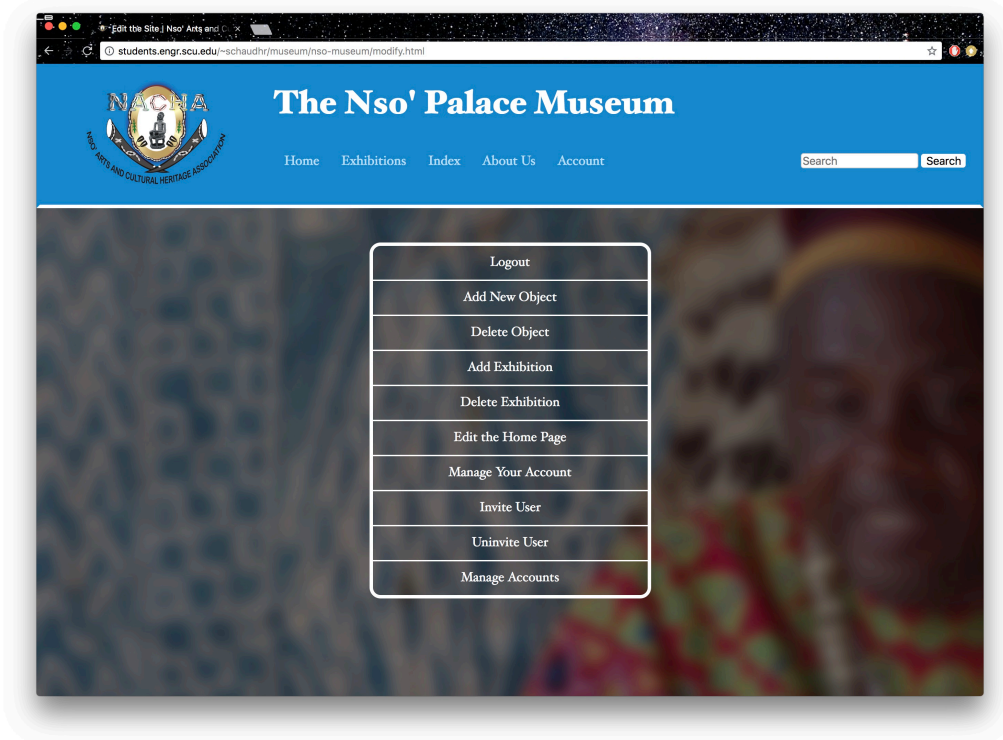


Figure 3.12: The administrator home page.



Figure 3.13: The mobile view of an object page.

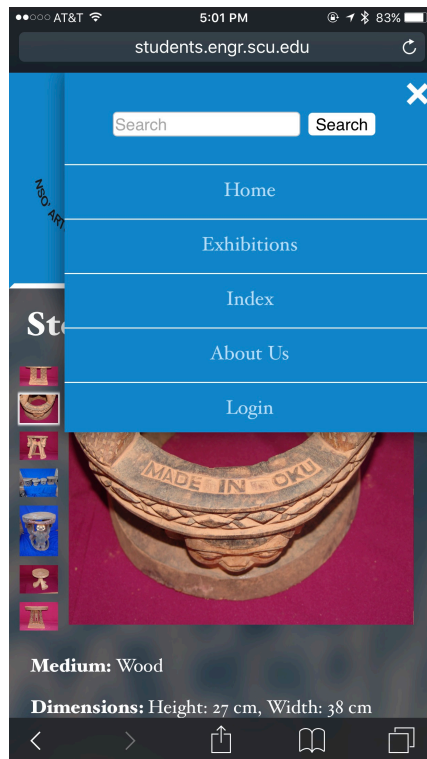


Figure 3.14: The navigation menu for devices with small screens.

Chapter 4

The Management

4.1 Testing

The following section describes how we tested our system to ensure proper functionality and usability for all who access our site.

- **Alpha Testing**

This is the testing that was done internally, by us, the developers:

- *Unit Testing*

Unit testing is a level of software testing where we test individual units of the software, such as functions, to validate that each unit performs as expected. It is a form of white box testing, a software testing method where the internal implementation is known to the tester. We implemented said unit testing throughout the development process to ensure that the individual components of our website perform as expected.

- *Integration Testing*

Integration testing is a level of software testing where we expose bugs in the interactions between different units. We used this type of testing when adding new features to our site to ensure that all of the components of our site function properly with respect to one another.

- *System Testing*

System testing is a level of software testing where we test a complete and integrated system to make sure it meets all the specified requirements. We performed this type of testing towards the end of our development process so that we could be certain all of the necessary functionalities work as intended.

- **Beta Testing**

This is the testing that is currently being done externally, by people who represent end users such as researchers and administrators:

- *System Testing*

To implement this type of testing, we asked other people, such as fellow students, friends, and members of NACHA, to use the fully integrated system and tell us about their experience. This is being done as black box testing, as none of the aforementioned people have knowledge of our internal implementation.

4.2 Challenges

4.2.1 Working With a Client

Naturally, working with a client led to some challenges. The two main problems we encountered were indecisiveness and a lack of access to content. Although our client was typically quick to respond, they were unsure about what exactly they wanted, especially in the beginning. In some cases, they also wanted to get feedback from their contacts who were more knowledgeable about the Nso' culture so that it could be accurately reflected in the website design and layout. While this was a useful idea, this long chain of communication to and from our client led to a very delayed requirements specification for the virtual museum, which in turn delayed our entire development process.

The second challenge we faced while working with our client was a lack of access to concrete content. We were initially given access to a lot of the research that was done, however, it was soon taken offline due to the client's online cloud storage constraints. Furthermore, while our client did have a large database of objects, they did not have any of the other content planned out (such as the content and layout for the exhibition and about us pages). In the end, all of this meant that we were designing for content that didn't really exist yet, which overall made our development process more difficult.

4.2.2 Development

Some of the challenges we came across while building our virtual museum came from our team's minimal web development experience. Although we each had some level of web programming experience, we were relatively new to web development, so there was an initial learning curve that increased the amount of time we spent in the implementation phase.

Chapter 5

Societal Issues

5.1 Ethical

Some of the ethical questions that were raised in our meetings with our client, NACHA, highlighted the need to preserve the art, history, and traditions of the Nso' people. One of NACHA's goals is to help those in Cameroon to prioritize the preservation of objects significant to their culture. Not only are many artifacts not getting the attention that they need in order to be properly preserved, but due to the political unrest in this region, many of these objects are also in danger of being completely destroyed. Additionally, there are Nso' objects (including a significant cowrie shell statue) being held in museums around the world because there is not a place in the Nso' Fondom where the objects can be brought back and guaranteed proper preservation. A long-term goal of NACHA's is to build a physical museum in the Nso' Fondom so that these items can be brought back to the Nso' people and still receive the proper care that they need. As such, the website that our team created will be a resource to the Nso' people, researchers, and anyone around the world who wants to learn more about the Nso' Fondom. Hopefully, it will also be a tool that NACHA can use to pave the way to getting funding for a physical museum.

5.2 Social

We built our website for NACHA and for the Nso' people in Cameroon. Therefore, we hoped to create a design that would be the best representation of their traditional and cultural values. Our contact in NACHA allowed our team to make many of the design choices for the website. Due to our limited contact with the Nso' people, it was not always clear to us whether our design was an accurate representation of what they would want. It is difficult to make a website and expect that an entire people group will be accurately represented, thus, we focused primarily on creating a design that would put the spotlight on the objects and the work done by the researchers.

5.3 Political

Our website is, in some ways, a result of the political tension that has risen in Cameroon, Africa. Our client, Alison from NACHA, would not have been put in touch with the Frugal Innovation Hub if she did not feel as though something needed to be done in order to assist with the preservation of objects in the Nso' Fondom. Alison hopes to use this virtual museum to raise awareness to the situation in Cameroon in order to prevent political tension from destroying the unique culture and objects found there. Creating a virtual museum will also help those that visit it to build an

appreciation for other cultures. This promotion of knowledge and appreciation of people and cultures that are different is a good way to create environments that foster mutual respect and ease political tension.

5.4 Economic

The majority of the resources that we used to build our website were provided to us by the Frugal Innovation Hub. One such resource was an AWS account, which allowed us to use Amazon's web servers to host our website and database. The only other cost associated with maintaining the website would involve the purchasing of a domain name.

5.5 Sustainability

Our project is sustainable and efficient because it can be easily updated and maintained to provide accurate information about the Nso' people. As new information becomes available, researchers are able to add, edit, and remove content from the website. By making a website, we have also ensured that anyone with a web-enabled device is able to access our system. Furthermore, we primarily use basic, core web technologies. Thus, our website will stay viable as long as the Internet is functioning.

5.6 Usability

The design and layout of our project make it intuitive and easy for all users to understand. The general functions of our website, such as searching and browsing exhibits, can be started from the home page where the user can then select any of the navigation tabs in order to continue. Functions that can be performed by administrators and researchers can be easily found on the first page they are directed to after logging in.

5.7 Lifelong Learning

Working on this project has helped our team become more familiar with available web development tools. We both began with minimal web development experience going into the project, therefore much of the initial implementation period was used to teach ourselves how to use common web development technologies. After having now built a fully-functional, visually appealing, easy to use system that fulfills all of the required functional and non-functional requirements of our project, we have gained confidence in our ability to learn new development tools and languages for future work.

5.8 Compassion

Our project displays compassion in that the virtual museum is a resource to bring awareness to a group of people that is in danger of losing its unique and rich culture due to political unrest and poor artifact conservation. This website gives people from around the world the ability to access and share knowledge from the Nso' Fandom with others. Therefore, the website raises awareness about the Nso' people, which is compassionate because raising awareness about them and the problems they face is the first step to finding and implementing an effective solution that benefits all stakeholders involved.

Chapter 6

Conclusion

Our motivation for this project was to make the objects that the Nso' Arts and Cultural Heritage Association have collected available to people all over the world. Due to the political unrest in the area, it is difficult to visit the Nso' Fondom and see these objects and the culture associated with them in person. Furthermore, the Nso' youth themselves are becoming more interested in modern culture over traditional culture. Thus, historical objects are not being properly cared for, oral stories are being forgotten, and traditional rituals are not being recorded for future generations. A virtual museum will help preserve and spread knowledge of the cultures and traditions of Cameroon in an easily accessible way. It will give the people from that region a way to protect their history in a way that will enable the rest of the world to experience the rich culture of Cameroon as well.

6.1 Future Work

Some potential future work that could be done on our website has been discussed at some of the meetings we had with our client. In regards to the website content, we would like to expand our resources to support video and audio files. For example, this would be helpful when a mask is added to an exhibit. In addition to the image of the mask, a recording of the ritual/performance it is used in could also be included to give the item a more holistic context. Rather than each object simply containing a static image, as is seen in many virtual museums, we want users to be able to see and enjoy the unique features of this living culture. This would also help our virtual museum to save things such as oral stories told by Nso' elders or the process of an Nso' woman weaving a basket. Another feature that our client was interested in implementing was an online store where people from the Nso' region could put items they had crafted up for sale for people around the world to buy. This would be another way for people to connect with and to gain awareness of the Nso' people and their traditions in Cameroon, Africa.

Bibliography

- [1] Alison Roth. 2017. Personal interview with a member of NACHA: Nso' Arts and Cultural Heritage Association. (October 2017).
- [2] Where We Work. Bui Family Union - USA, www.bfu-usa.org/index.php/who-we-are/where-we-work.

Appendix A

User Manual

This section provides a detailed description of all the functions available on our virtual museum and is a resource to those who use our website. All users are able to browse and search for objects/exhibits on the website. This includes being able to access the Home, Exhibitions, Index, and About Us pages, as well as all object and exhibit pages. The following sub-sections outline the functions that are available only to researchers and administrators.

A.1 Account Creation

Accessible by: Invited Users

Step 1: From the invitation email, click the link that will take you to the account creation page. If no email was received, go to your spam/junk folder to double check, and then contact an administrator so that you can be invited again. Once invited, another email will be sent to you.

Step 2: After clicking the link, enter the email that was used to invite you and pick a password you would like to use to log into your account. The password must be at least eight characters in length.

Step 3: Select the “Create Account” button to finish. An email will be sent to your email asking you to verify your account. After verifying, the email and password may now be used to login to your account.

A.2 Login

Accessible by: Administrators and Researchers

Step 1: Ensure that you have already been invited by an administrator and have created an account (see section A.1).

Step 2: From the website, select the “Login” menu option.

Step 3: The user may then enter their account credentials and click “Login” to gain access to their account.

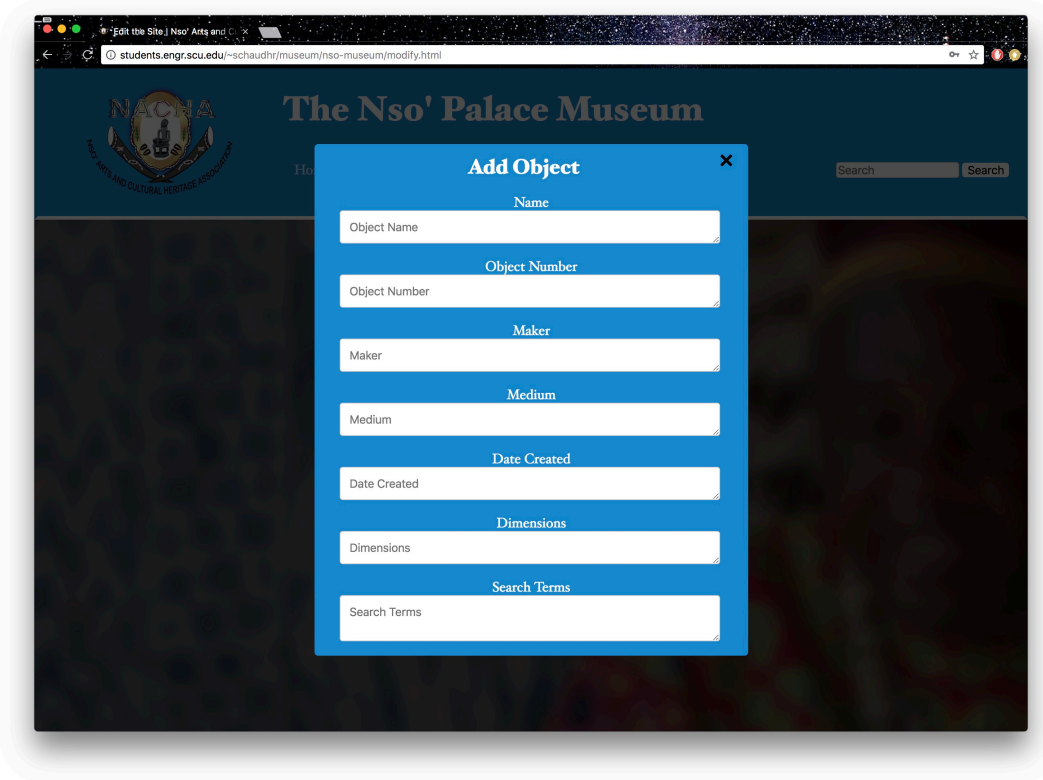


Figure A.1: The form to add an object to the system.

A.3 Logout

Accessible by: Administrators and Researchers

Step 1: You must already be logged in to the site. Select the “Account” menu option.

Step 2: From the Account page, select “Logout” and confirm your decision to be logged out of your account.

A.4 Add New Object

Accessible by: Administrators and Researchers

Step 1: After logging into the account, select “Add New Object” from the Account menu.

Step 2: Fill in all relevant or required fields for the object and then select “Add Object” (Figure A.1). The object will automatically be added to the Index page and any comma-separated Exhibition that was specified in the “Exhibitions” field of the form.

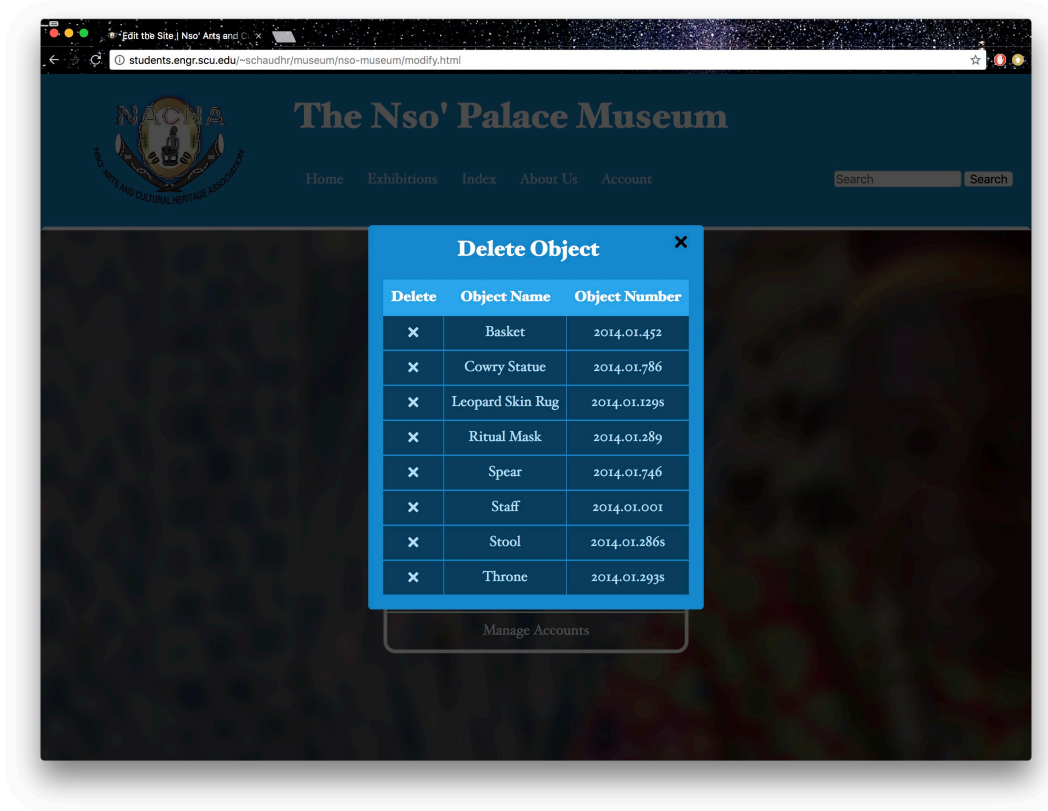


Figure A.2: The popup to delete an object from the system.

A.5 Delete Object

Accessible by: Administrators and Researchers

Step 1: After logging into the account, select “Delete Object” from the Account menu.

Step 2: Select the “X” next to the object name and number in order to delete it (Figure A.2).

A.6 Add Exhibition

Accessible by: Administrators and Researchers

Step 1: After logging into the account, select “Add Exhibition” from the Account menu.

Step 2: Fill in the required fields and click the “Add Exhibition” button when done.

A.7 Delete Exhibition

Accessible by: Administrators and Researchers

Step 1: After logging into the account, select “Delete Exhibition” from the Account menu.

Step 2: Select the “X” next to the exhibition name and description in order to delete it.

A.8 Edit the Home Page

Accessible by: Administrators and Researchers

Step 1: After logging into the account, select “Edit the Home Page” from the Account menu.

Step 2: Fill in the required fields to make changes to the website home page, then select “Update Home”.

A.9 Invite User

Accessible by: Administrators

Step 1: Be successfully logged into the site as an administrator.

Step 2: Select “Invite User” from the menu shown (see Figure 3.12).

Step 3: Enter the email address of the person you would like to invite. From the selection box titled “Select Account Type” choose whether the user you are inviting will be an administrator or a researcher.

Step 4: Select “Invite User” to finish. An email is automatically sent to the user letting them know that they have been invited to create an account.

A.10 Uninvite User

Accessible by: Administrators

Step 1: Be successfully logged into the site as an administrator.

Step 2: Select “Uninvite User” from the menu shown (see Figure 3.12).

Step 3: A list of all users that have been invited, but have not yet created their account, is shown.

Step 4: Select the “X” next to their email and account type to remove their invitation.

A.11 Manage Accounts

Accessible by: Administrators

Step 1: Be successfully logged into the site as an administrator.

Step 2: Select “Manage Accounts” from the menu shown (see Figure 3.12).

Step 3: Select the “X” next to the email of the researcher or unverified user that you would like to remove in order to delete their account.