Usability Problems Identified and Fixed

Problem	Severity	Nielsen Heuristic (Aela, 2022) (Nielsen, 2005)	If fixed, then how?
No consistency between pages	Very High	Consistency and standards	Created an accessible design that's used across all pages.
Posters for each film don't load	Very High	Recognition rather than recall	Replaced the placeholder images with the correct images
The main shop page isn't uniform	Very High	Aesthetic and minimalist design	Changed the layout of the page to keep posters, names & descriptions and add to basket in line with each other.
Visual feedback needed when adding movie to basket	Medium	Visibility of system status	Number of items is displayed on the navigation bar.
Letters can be added into the "Days to rent:" input causing a null error	High	Error prevention	An error message now appears if text was added.
No time limit on renting films	Low	Error prevention	If you try to add more than 14 days an error message appears.
The website doesn't inform the user when they have done something to cause an error	High	Help Users Recognize, Diagnose, And Recover from Errors	An alert now pops up for bad user inputs on the shop page.
The website loads on an index of all the pages	Very High	Consistency and standards	The website now loads into the shop page
The descriptions for some films are incorrect	Medium	Recognition rather than recall	Replaced the incorrect descriptions with the correct ones.
No visual system for progress through the payment system	High	Visibility of system status	Boldness of cart text changes when in the cart.
Navigation through pages is very difficult	Very High	Flexibility and efficiency of use	Adding in a navigation bar, this will allow users to see all the options available to them
Login page is inconsistent with most login pages	High	Consistency and standards	Redesign the login page to highlight the login button and separate out the register account button.
Continue shopping button doesn't reroute to the shop page	Medium	Error prevention	Made a clearer button that reroutes users back to the shop page
Clicking the top left title for the website doesn't route back to the main page	Medium	Flexibility and efficiency of use & Consistency and standards	Created a logo and made it a hyperlink for the home page
Overhaul design to make it accessible and cleaner	Very high	Aesthetic and minimalist design	Created a master stylesheet with a better design for each page.
Website has no help/support page	High	Help and Documentation	Added a help page that can be accessed via the footer
Website has no error page	Medium	Help users recognize, diagnose, and recover from errors	Created a help page that users are routed to when errors occur with helpful information.
Basket page needs an overhaul to make the design usable	Very High	Flexibility and efficiency of use	Fixed the inconsistent visual design and implemented features to make it functional.

Colour buttons to match users' mental model	Medium	Consistency and standards	Made remove buttons red and add buttons green to match the usual conventions
Changed the size of text in each film card to show visual hierarchy	High	Consistency and standards	Made the film title font larger and actors name bolded
Images don't have alt text describing what they are	High	Consistency and standards	Added in alt text for the posters and banners on the page for if it doesn't load for a user or they use a screen reader.
No error feedback in checkout system	Medium	Visibility of system status	A small information pop up appears if a field isn't filled.
No genre filters on shop page	High	Flexibility and efficiency of use	Created a tab for genre filters, multiple genres can be selected at once
No search bar on shop page	High	Flexibility and efficiency of use	Created a live search bar that can show all the films that fit what's typed in
No price filter on shop page	High	Flexibility and efficiency of use	Created a slider that can filter the films by price
No continue shopping or return to store button	Low	User control and freedom	Created a continue shopping button
No method of emptying the whole cart at once	Low	Flexibility and efficiency of use	Created an empty cart button to shortcut emptying the basket
Cannot login using either username or email	Low	Flexibility and efficiency of use	Allowed users to choose whether to login with their username or email and communicated this to the user
Non-constructive error messages when logging in/registering an account	Medium	Help users recognize, diagnose, and recover from errors	Created constructive error messages to instruct the user on how to create an account/login error free
Users could checkout without an account	Medium	Error prevention	Checking out without an account could cause errors within the system and potentially cause the user to not be able to receive their films so we the user must be logged in to checkout
Doesn't allow users to login or create accounts	High	Consistency and standards	Pages with a login button are expected to allow account creation and logging into an account so we added this functionality
Did not allow user to logout	Medium	User control and freedom	The user can now logout
The same film could be added to the basket multiple times	Low	Error prevention	The add to cart button becomes greyed out when the film is in your basket and doesn't allow a film to be added twice.
No visual feedback of being logged in	Low	Visibility of system status	Added visual feedback to show that the user is currently logged in
Filters do not stay applied	Low	Flexibility and efficiency of use	Made the filters stay selected so a user can refine their search without having to re-apply filters
Movie posters were not clickable	Low	Flexibility and efficiency of use	Posters can now be clicked to view more info
Users carts were not saved between sessions	High	Flexibility and efficiency of use	Used cookies to maintain the users cart between logins.

No ability to update days rented on the basket page	Medium	Flexibility and efficiency of use	Allow users to update the days rented on the basket page
No trailers displayed on the movie information page	Low	Consistency and standards	Trailers for the movies can be seen on the movie info page.

Individual Contributions

Website on OpenStack: http://10.10.3.197

Benas Miliauskas

- The cart page design and it's functionality
- Add-to-cart functionality
- Update movie quantity functionality
- Removing movies from cart functionality
- Certain button functionality: buttons get disabled to prevent certain user actions
- Checkout page
- Contributed to the overall look, design and style of the pages

Razvan Cristea

- Contributed to the genre filters
- Completed the movies database and later added the movie trailers field
- Fixing CSS over the website
- Made an intuitive live search bar
- Changed the appearance of the live search bar to be more inviting to use
- Added movie trailers on each of the movies' pages to ensure user retention
- Made the movie title and image clickable for intuitiveness and ease-of-use
- Contributed to the overall look, design and style of the pages

Rory Head

- Worked with Rhys to ensure that the filter options were retained on page refresh, such as when the filters are set, including displaying this
- Implemented the genre filters
- Created the login and registration pages
- Implemented login, logout and registration functionality using SQL
- Added visual feedback for when the user is logged in and how to log out
- Implemented useful and constructive error messages for errors within the registration and login process, and implemented checking on the input boxes, I.e. the passwords match
- Requires the user to log in/register before they can checkout
- Login and register pages correctly redirect to the previous page
- Implemented cookies to save a user's cart state between sessions
- Contributed to the overall look, design and style of the pages

Rhys Davies

- Increased accessibility by allowing text to be read on dynamic backgrounds through use of a solid backing.
- Created and implemented the error page, which is used as a replacement for a generic and confusing 404 page, as well as a redirect location if the movie ID requested doesn't match an available film
- Created an about us page, linking to it in the footer of every page

- Worked with Rory to ensure that the filter options were retained on page refresh, such as when the filters are set, including displaying this
- Correctly implemented the functionality of the price filter
- Contributed to the overall look, design and style of the pages

George Liddell

- Report write up
- Security recommendations
- Created an about us page, linking to it in the footer of every page
- Created a logo for the navigation bar and the tab of the website
- Contributed to the overall look, design and style of the pages

Niall Hewlett

- Login page design that conforms to the common mental model that users will have for a login page
- Register page design with usability in mind
- Ensuring design consistency
- Contributed to the overall look, design and style of the pages

Steven Cooke

- Contributed to the overall look, design and style of the pages
- Used a Header element in implement all the head tags of the webpage into one file, including the navbar element which can then be include on every page to ensure all pages on the site have the same head tags, css and navigation bar
- Using the same method as the head I implemented a footer element to round the page off and give a better user experience. This was also implemented on every page using php
- Developed the design for the detailed movie info screen so the user can see more information about the film they are thinking of renting.
- Completely overhaled the design of the shop page to have uniform sizing of all the movie cards. Pulling the information for each movie from the backend database and constructing an individual row element for each movie. Also implemented the carousel at the top of the page to show 3 random featured moves every time the user refreshes the page
- Created an entirely new checkout page that follows the same design style as the rest of the website. The page has validation to ensure that all required fields are filled in and that the card number they enter is a valid visa or Mastercard.
- Ensured consistency between the pages

Heuristic Principles Breakdown

In this section, we will explain in detail each heuristic principle and how we went about designing our website with them in mind.

Visibility of system status

Nielsen describes this as *"The system should always keep users informed about what is going on, through appropriate feedback within reasonable time."* (Nielsen, 2005). For our website, we wanted to make it clear to users at every stage what was happening during interactions, we achieved this by for instance having text boxes come up when errors occur as shown in figure 1 when a user incorrectly fills out their billing details, this happens again when they incorrectly enter their credit card number. By notifying users when they make an error, they can respond accordingly and avoid being frustrated. We also utilised this usability principle when adding films to the cart, with the prototype you couldn't tell if the button added a film to the cart whereas now there is visual feedback showing the user their interaction has worked.

Figure 0-1 An error appearing during checkout

Match between system and the real world

Nielsen says *"The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order."* (Nielsen, 2005). Users of websites will apply their real world understanding of systems so we chose to design certain elements of our rentals website with the real world in mind. For example, as the website is e-commerce, we refer to the collection of items the user wants to buy as the cart to match a shopping cart. We allow users to learn more about the film they want to buy as if they were looking at the back of the box. We also colour certain items to match the real world meaning, the checkout is green as that usually means to go and remove buttons are red.

User control and freedom

Quote *"Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo."* What this meant for us was making sure users found it easy to remove films from the cart if they were to change their mind. In the original prototype users couldn't remove specific films from the basket, only empty the entire basket. Therefore, we implemented controls to remove each individual films so that users didn't feel trapped in their decisions.

Consistency and standards

Nielsen describes these principles as *"Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions."* (Nielsen, 2005) This is split into two categories, internal and external consistency. Internal consistency is keeping colours, design and layout across different pages on the website. The prototype was different from page to page, so we implemented a master style sheet with an agreed upon design, we then made sure all the pages fit this design. External consistency is making sure what you make is consistent with the mental model that users' already have from their experience with other websites. For instance, we redesigned the prototypes' login page to better fall in line with the common login page.

Error prevention

"Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action." (Nielsen, 2005). This is trying to pre-emptively predict what users could do to cause errors (intentionally or otherwise) and implementing features that stop them from happening. To ensure that users encountered as few errors as possible we used PHP, this would manage errors and be able to tell users what the issue was if they encountered one. We also fulfilled this principle by going through the prototype and fixing many things that were causing errors. One example of this was adding an upper limit of two weeks (14 days) to the rent time as in the prototype large numbers would break the checkout system.

Recognition rather than recall

This is like external consistency, described as *"Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate."* (Nielsen, 2005) In the original prototype users would be forced to remember each film from title alone as neither the posters nor the descriptions loaded correctly. This was a critical issue that we identified and quickly fixed, now users can recognise films visually from their posters and if that is not enough, they can be helped by correct descriptions.

Flexibility and efficiency of use

"Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions" (Nielsen, 2005). For inexperienced users the main way to navigate the films would be to scroll though the film cards, however, to increase efficiency we've implemented a live search bar to take users directly to films. There's also genre and price filters for experienced users who may not have a specific film in mind. This flexible searching system where there are three ways to find a film can tailor the experience for all users.

Aesthetic and minimalist design

"Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility" (Nielsen, 2005). The original website has no structure in pages or between the different pages, this means that even with a minimalistic (barebones) design the information is still hard to discern. Our redesign highlights information better while still being minimalist, data is grouped and the colour scheme is kept limited to stay clean. Our website is significantly more aesthetically pleasing when compared with the prototype while also being more consistent and even easier to process for the user.

Help users recognize, diagnose, and recover from errors

"Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution" (Nielsen, 2005). A previously mentioned change that we added to the website also applies here, when filling out the billing address the website tells you if errors have been made. This is done with a pop-up and a small icon, visually this signifies to the user that an error has been made without them needing to properly read the text. This was completely lacking from the prototype and we felt it was very important to implement this to ensure the user experience was as easy as possible. We also implemented an error page which helpfully guides the user back to the correct pages, this was a critical issue that was identified in the prototype.

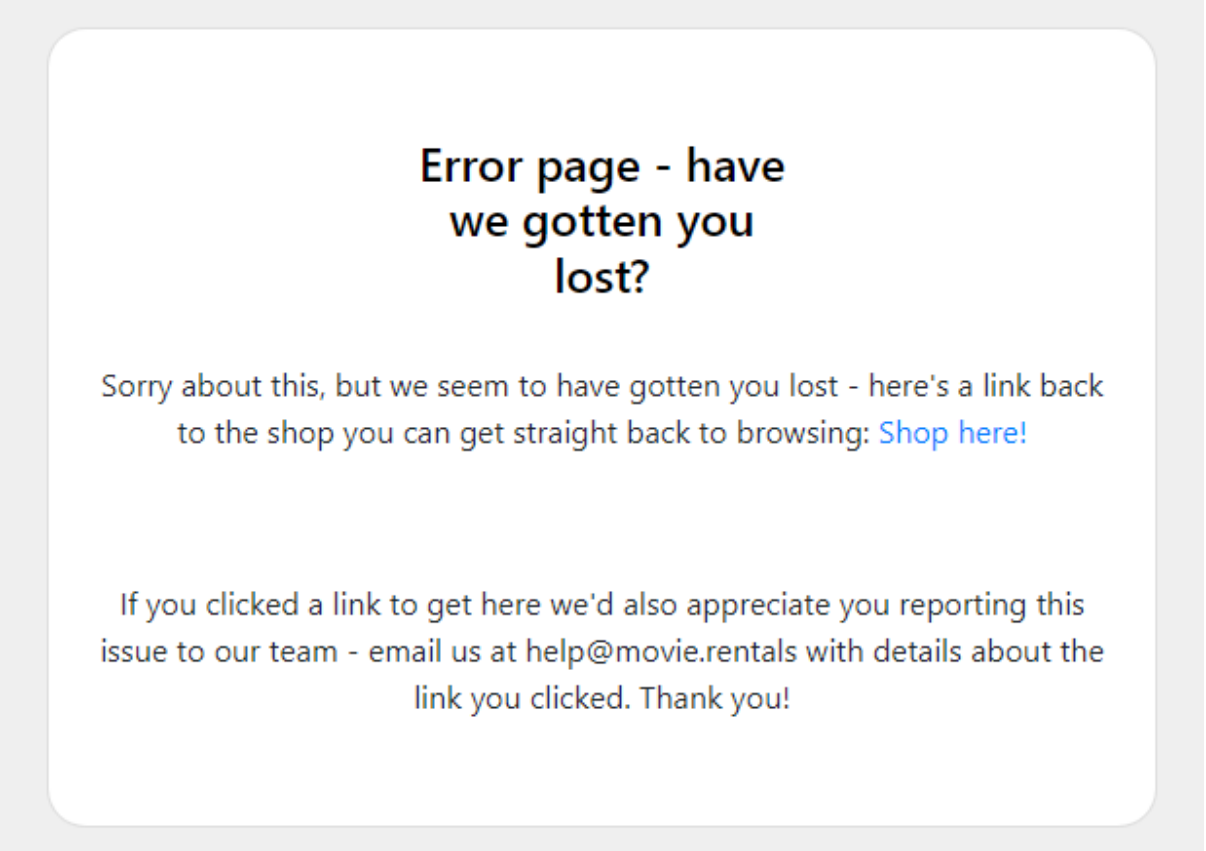

Figure 0-2 The error page

Help and documentation

"Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large" (Nielsen, 2005). To ensure that if the user needed any help using the website, we implemented an about us page with three forms of communication. This is found in the footer from the website, which is consistent with what most users will have for where to get help.

Security Recommendations

The OWASP benchmark is an open-source test suite that is used to evaluate the strengths and weaknesses of vulnerability detection tools (CodeThreat, 2022). There are several weaknesses that can be found within a piece of software including:

- Insecure hashing & encryption algorithms
- SQL, LDAP, command and XPath injection
- Path traversal
- Trust boundary violation
- Insecure random number generation
- Cross site scripting
- Missing cookie secure attribute

These weaknesses are important to protect against, for example when storing login credentials for the users. We've implemented a system that will store a hashed version of a password that a user would enter when registering, this is then stored in a database. We would recommend in the future for a random cryptographic salt to be added to the hash. This is a random piece of data that is appended to the input so that when put through the hashing algorithm a completely different output is created (Arias, 2021). This means that if two people were to enter a simple password like "12345678", they would both look different to each other, which helps to negate the risk of rainbow tables being used to easily gather passwords after a breach.

For hashes to be effective they also need to be up to date, ideally recommended by NIST. Currently the site uses md5 hashes for storing passwords, which are insecure, and easily broken with modern techniques and technology) (Manley, 2020). To improve this, we can use NIST recommended algorithm such as SHA-256. This can be easily implemented using inbuilt PHP functions.

As we utilise databases, it's also important to recommend input sanitisation whenever user input is used. This is most commonly found in filtering ' and " characters from the raw input as these can be used to manipulate SQL commands to manipulate the database through user commands being issues – this can be seen in displaying sensitive information, to deleting full databases. (Future Learn, n.d.).

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