Concordia University
Engineering and Computer Science

SOEN 6011 (SUMMER-2020)

SOFTWARE ENGINEERING PROCESSES

SESTOPIA: Deliverable 1 Report

TEAM D

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Declaration

We, the members of the team, have read and understood the Fairness Protocol and the Communal Work Protocol, and agree to abide by the policies therein, without any exception, under any circumstances, whatsoever.

Project Link: http://sestopia-d.epizy.com/index.php

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List of Abbreviations

Table 1. List of Abbreviations

Abbreviations	Description
RDD	Responsibility Driven Development
CRC	Class Responsibility Collaborator
WCAG 2.0	Web Content Accessibility Guidelines
MVC	Model-View-Controller
UML	Unified Modeling Language
HTML	Hypertext Markup Language
PHP	Hypertext Preprocessor
CSS	Cascading Style Sheets
SQL	Structured Query Language

1. Outline of Process

1.1. Introduction

This document includes the set of interrelated artifacts and their descriptions created for fulfilling the requirements of the course project for SOEN 6011. The forthcoming sections are intended to provide the solutions for multiple problems given in the description of deliverable 1.

1.2. Rational/Motivation Behind Choosing SESTOPIA

The team did intensive research using the internet on various web applications used these days and the terminology associated with them. The research was motivated to understand and uncover the possible knowledge gaps in the minds of team members so that the final selection of application should be free from any cognitive bias, prejudiced decisions. The team tried its best to choose the application objectively that should meet the constraints mentioned in the project description in an intended way.

The use of these Web technologies is aligned with the software engineering principles of separation of concerns and modularity.

1.3. Brief description of the process

SESTOPIA is an information-intensive Web Application. SESTOPIA should, in principle, be accessible to anybody, anywhere, using any interactive device connected to the Internet's **[1].** SESTOPIA acts as a knowledge repository that hosts informative content for different skills **[2]**. The available content on SESTOPIA is both technical as well as non-technical in nature. User communication can take place through web applications.

2. Design Thinking & Critical Decisions

2.1. Design Thinking Process

Design Thinking Process consists of 5 stages as shown in figure 1. It is non-linear and iterative in nature. During the first iteration of designing and planning our website, we could easily reduce work efforts on defining the problem statement as it was articulated for us.

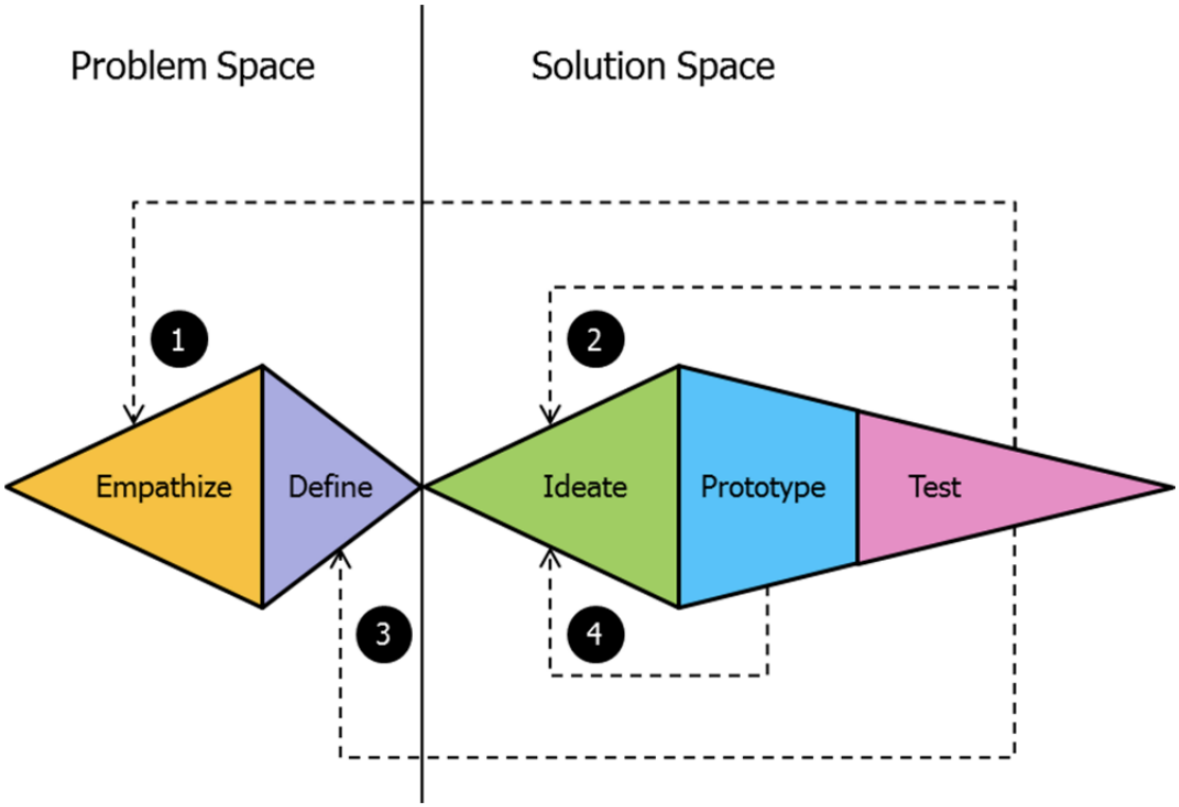

Figure 1. Typical Design Thinking Process [4]

The next step was to ideate the structure and determine if the compatibility aspect should meet modern UI standards, as influenced by daily browsing and average websites preference was towards implementing the material design, but it would require additional resources to be used in addition to the requirements specified i.e. HTML, CSS and JavaScript, hence the idea was discarded, it was decided that the project will be developed using languages specified in the project description and a simple website was prototyped using basic HTML.

A requirement in the project description was that the website should comply with section 508 or WCAG 2.0 Level AA. It was necessary to understand what it meant and hence began the stage to understand these guidelines and build empathy to incorporate accessibility for various types of users and construct it into the project by implementing necessary additions like contrast, readability and placements of elements. This Stage again required ideating and prototyping. The website was tested for compliance with the guidelines specified by using a tool.

An important factor that was realized during a later stage, was that accessibility would also mean empathizing with users utilizing legacy technology which may not support widespread general modern tech like JavaScript. This late realization cost the team double efforts since it meant refactoring the current architecture and modularising different aspects using a technology which was not present currently in the architecture, we had to incorporate PHP and implement an online database to save the website from displaying empty pages for those users whose browsers don't support JavaScript.

2.2. Design Consideration Decisions & Proof of Concepts

The decision was taken for making Sestopia accessible and consistent many critical decisions were taken into effect and they are as follows:

1. **Readability:** According to the ideation phase only a selected few simple CSS styling were to be used, like cards with a slight elevation, even spacing between various sections.

Figure 2. Cards Design - Proof of Concept

2. **Navigability:** An index with links has been used to navigate at the desired content section at the beginning of every content page for easy navigation. A hovering To-Top-Button at the bottom right for navigating back to the start of the page.

Figure 3. Content Page Navigation Bar - Proof of Concept

3. **Accessibility:** Followed the WCAG 2.0 (Level AA), the steam used alternative text for the image tags, added labels to web widgets where necessary and colour palette for appropriate contrasting is used.

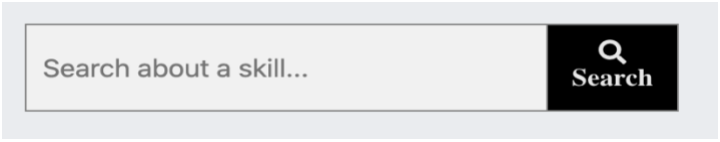

Figure 4. Search Button with label and Icon - Proof of Concept

4. **Consistency:** Design Structure consists of simple CSS styling for paragraphs, divisions for proper content modularization and usage of the same CSS classes on all pages for ease of use and UI consistency. We have maintained a table of contents on each page.

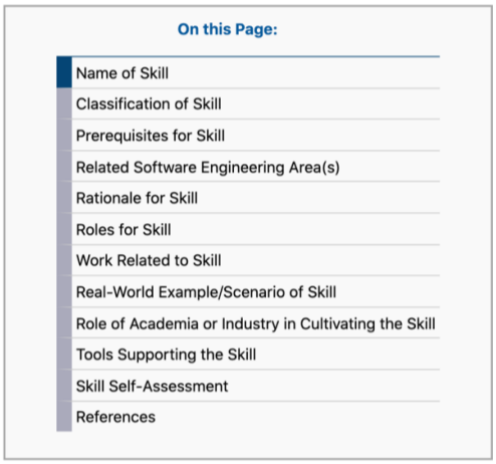

Figure 5. Table of Contents - Proof of Concept

5. **Affordances:** Hyperlinks are provided with underline tags, a scroll bar is provided to let a user scroll down to know the more, emphasis is given on an important word using the strong tag or bold tag. Here is an example of Go to Top button provided at every page in the right bottom of the screen showing affordances to go to the top of the page.

Figure 6. To top - Proof of Concept

6. **Theme:** Appropriate theme has been chosen and we used a bootstrap template and manipulated the colour contrast to make it look good. The homepage can be seen in Figure 7.

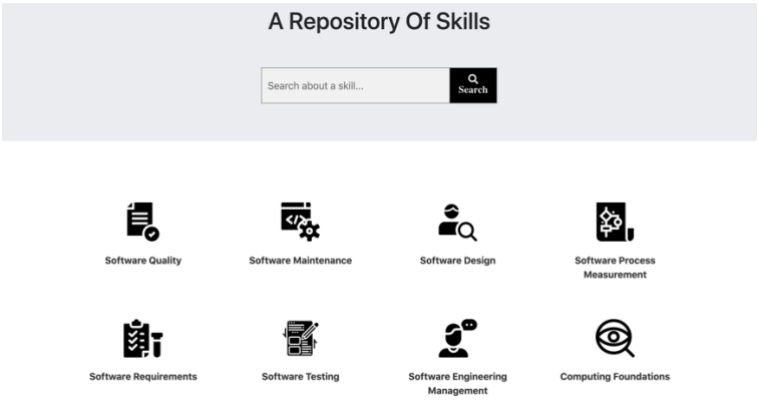

Figure 7. Homepage - Proof of Concept

2.3. CRC cards

As per the team's decision to follow the Responsibility Driven Development (RDD) approach, we created CRC cards for our system. It can be interpreted in the following manner as shown in Table 2.

Table 2. CRC card model for interpretation

Class Name	
Responsibilities	Collaborators

Class Name: It will represent the name of the class
Responsibilities: A set of responsibilities is possible for a given role as per the RDD.
Collaborators: The class sharing the data with are mentioned here (can be empty or any positive integer number of classes).

CRC cards designed for different classes present in Sestopia can be seen in Figure 2.

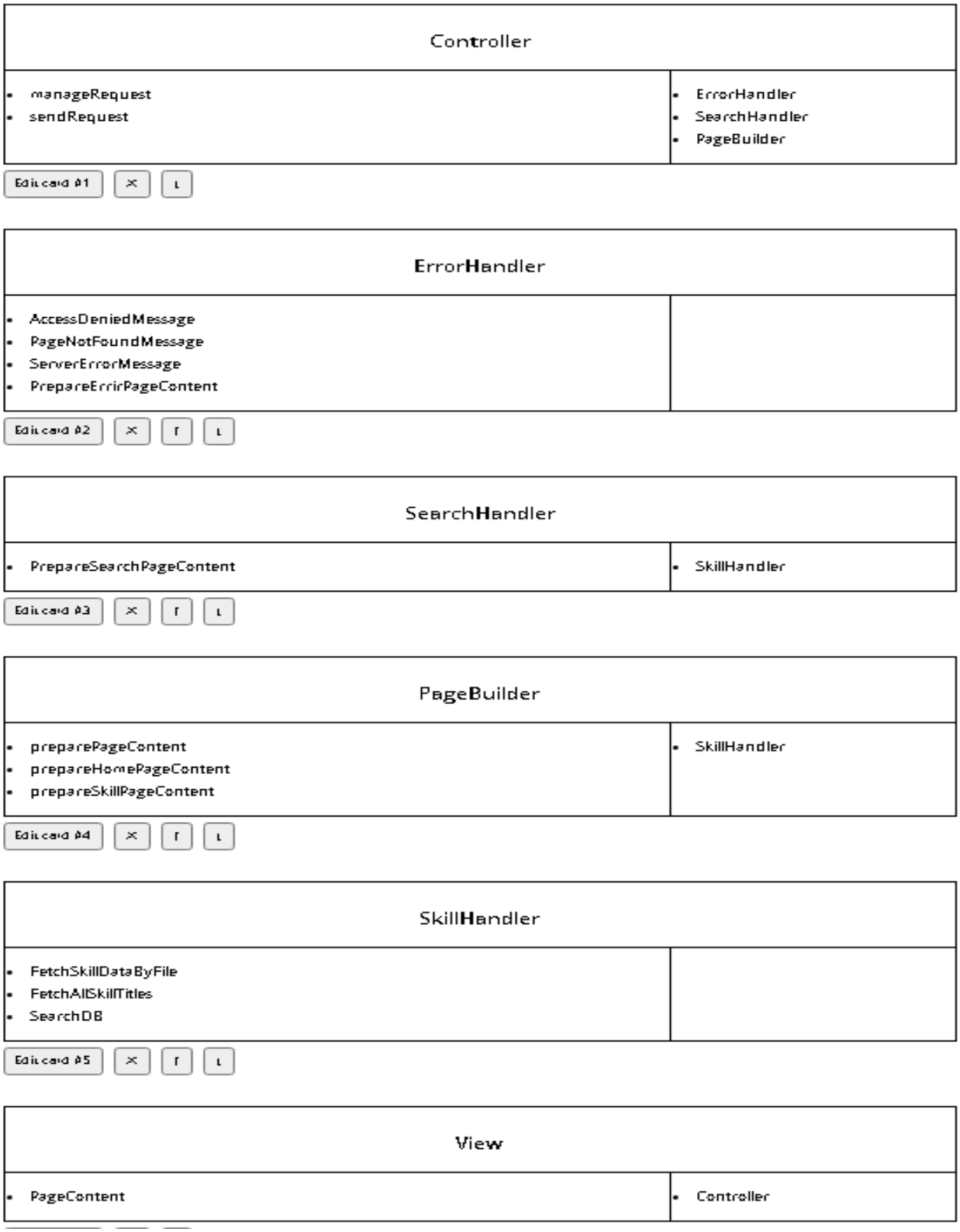

Figure 8. CRC card models for SESTOPIA (Developed using CRC card maker online tool [5])

2.4. The architecture used for the Development

For the development of the Sestopia webpage, the team decided to use Model-View-Controller architecture. This decision helped us in achieving the Modular Design. The UML diagram for the Sestopia can be seen in Figure 3.

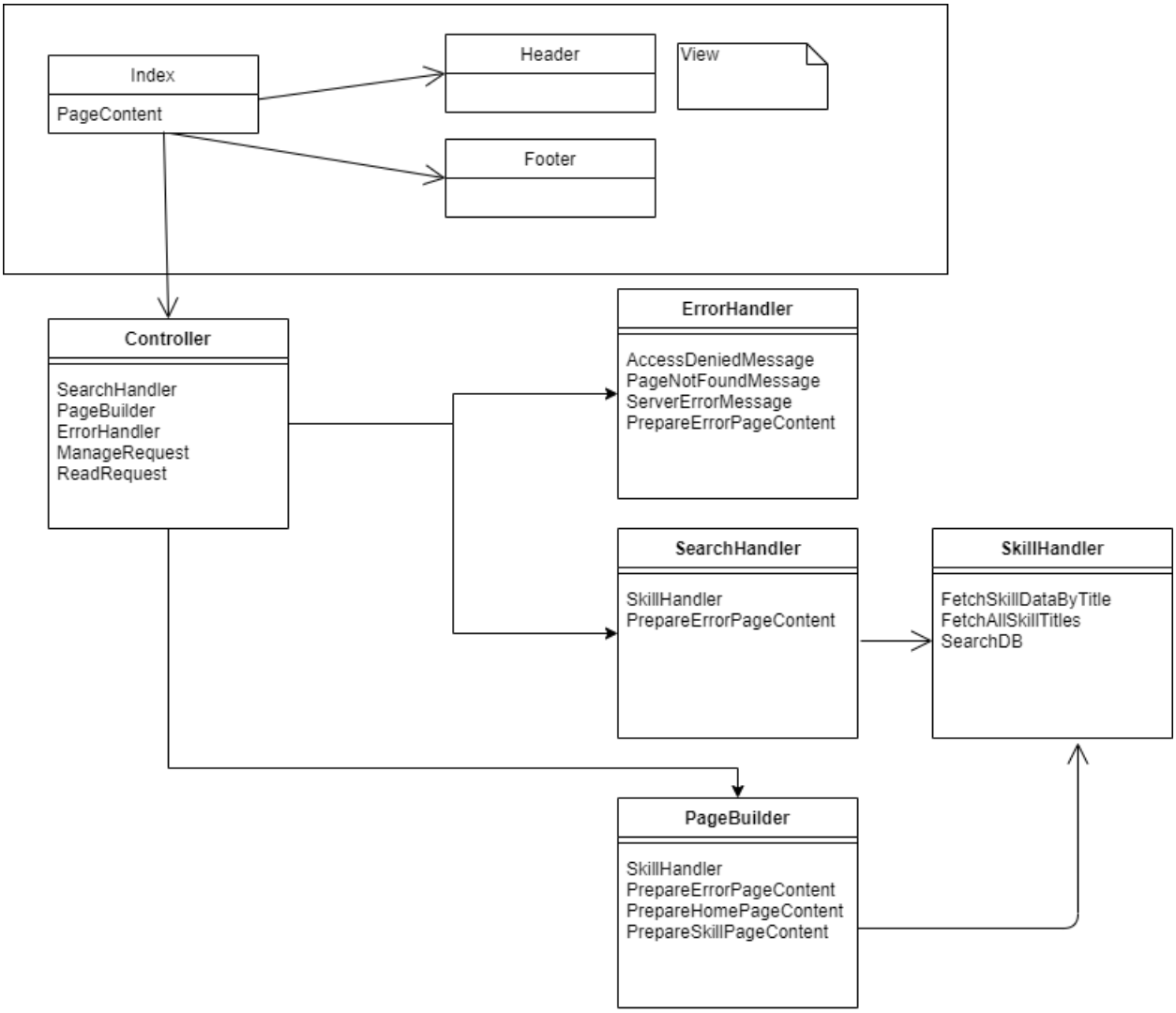

Figure 9. MVC UML diagram for Sestopia (Developed Using Draw.io tool [6])

2.5. Skill Selection Factors

It is very crucial to select skills appropriately in order to get expertise over skills. Major skill selection factors for each Knowledge Area is described are Table 1.

Table 3. Skill Name and Critical decisions

Knowledge Area	Skill	Critical decisions (Skill)
Software Design	User research and personas	As User research is all about information gathering from users, here project description played an important role in understanding the needs of the project. However, it was not clear enough to understand at first sight. As there were many references for building Sestopia, it becomes quite difficult to choose the best one which will be acceptable by users. Different persona expresses a different story but to come up with one design was difficult.
Software Quality	Conducting Reviews and Audits	The skill is what I am practicing currently in my organization. It needs expertise in understanding the standards of the system, functional, technical requirements.
Software Maintenance	Software reengineering	Skill selection factor: missing skillset as a freelancer. Helps provide a more finished product by improving overall efficiency and reduce cost by helping to provide a maintainable and easy to understand structure after speedily providing the initial version of the product.
Software Engineering Process	Software Process Measurement	Skill Selection Factor: Never had a chance to work in measurement activities in professional experience.

		To gain knowledge on the skill which would help me in the real-time to measure the software process or product.
Software Testing	Automate Unit Testing	Passing some relevant courses such as Advanced Programming Practices, Software Maintenance as well as having experience in various software development teams in my work experience helped me to get familiar with software testing methods such as unit testing. All these persuaded me to make a decision about choosing the software testing area and unit testing skill for this project. I did perform some unit testing both manual such as writing and automated unit testing before this course for some other project that I had. For Advanced Programming Practices, I did write over 100 test cases for testing the units in Risk game projects. Those familiarities help me to select this skill and area.
Software Requirements	Software Requirements Elicitation	Having passed the system software requirements course in university, I realized how important this skill is in software engineering. It is the first step in the lifecycle of the software product and if it isn't done properly the result would not be acceptable for the customers or stakeholders and all the other efforts would be wasting time and energy. This shows the importance of this skill and that it is worth spending time and energy to elicit the requirements properly.
Software Management	Scheduling	This skill is majorly the goal of my career, being great at this skill requires to master technical, soft and management skills and usually makes the difference between a successful and failure of a project.

Computing Foundation	Problem Analysis	Skill selection factor: Developing this skill in order to gain a problem-solving skillset. Gaining expertise over this skill could help in improving many development processes. I.e. to improve the knowledge over the problem space after exploring and to correctly identify the root cause of the problem before taking action to resolve it. This would save the efforts and time required to do problem-solving.

3. Tools and Technologies

3.1. Description and Limitations of Tools

Several Tools were used after checking the reliability of those tools to develop Sestopia. Few tools were used for testing the responsiveness and accessibility of the website. They are described in Table 4.

Table 4. Tools used for Development and Testing

Tool	Description	Limitation
Wave	Wave tool is an accessibility checker that helps the developers to verify WCGA errors and evaluate the web content based on certain guidelines [1].	- Gives False Negatives in situations where value or label attribute is not required to be provided on a particular element. - Tests one single page at a time and not a whole site.
AChecker	It is a Web accessibility evaluation tool used to evaluate HTML content for accessibility problems by entering the location of a web page, uploading an html file, or by pasting the source code. It also produces a report of all accessibility issues based on selected guidelines [19].	- Gives False-negative for not having title and language for the HTML document when HTML pages are being rendered using PHP. - CSS Validations are failing to show it inaccessible.

Responsive Test Tool	It was used to check the responsiveness of the website. If there are any responsive issues with the website, then we can make changes. We can check the responsiveness with respect to desktop, laptop, mobile, tablet, television. And not only that we can create the custom size of the screen to validate responsiveness [7].	- None Found
W3C Markup Validation Service	It was used to validate the HTML markup of the website to make sure it follows the formatting standards and prevent any errors as well as improving readability and search engine rankings.	- It can only check one page at a time. - Sometimes a simple typo can result in multiple errors which makes evaluating the correctness of our code complicated.
PHP MeekroDB library	It is a tool that simplifies connection to MySQL databases within PHP code. It reduces the number of lines of code required and makes SQL injection impossible.	- Since this is an extra library, code written and maintained by someone else, it adds to the software engineer's work by requiring regular updates on top of PHP updates.
PHP storm	It is an IDE for PHP coding that helps to avoid typos and recommend best practices while coding, which makes programming faster.	- Since our project was a simple website, we didn't even use a tenth of the features provided by this IDE and naturally, we didn't face any limitations.
Composer	It is a dependency manager for PHP which allows declaring libraries for each project and it will manage them automatically.	- Even though the composer simplifies the management of PHP libraries, but since it itself is a software, there is a need for updates.

phpMyAdmin	It is a free software intended to handle the administration in the MySQL over the web. It simplifies table creation and data insertion in MySQL database using an online graphical user interface [22].	- It is not possible to update multiple table rows at the same time, using the GUI.
MySQL	It is a visual database design tool that integrates SQL development, administration, database design, creation and maintenance into a single integrated development environment for the MySQL database system [21].	- MySQL does not comply with the full SQL standard for some of the implemented functionality [21].
XAMPP	XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages [9].	- It can be used to host live websites but would require lots of tweaks to be secure because it was built for local development projects. - We cannot predict the live server's functionality and performance based on the results of this tool.
GIT	It can be accessed and managed using the standard Git command-line interface; all standard Git commands work with it. Also, it enables users to access and browse public repositories through the hosting service on the internet which is GitHub.com [20].	- Git has no native GUI. This means that if you want a GUI, you're reliant on third-party software in addition to Git [16].

3.2. Description of Technologies

Table 5. Technologies Used

Technology	Description
PHP	It is one of the most powerful scripting languages that are used in web development environments to manipulate server-side requests [8].
JavaScript	It is a powerful scripting language to create and handle dynamic content in web development environments that enable developers to provide dynamic features such as animated graphics, interactive forms, etc. [13].
HTML	Hypertext Markup Language (HTML) is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript [10].
CSS	CSS describes how HTML elements are to be displayed on the screen, paper, or in other media and control the layout of multiple web pages all at once [11].
SQL	SQL is a domain-specific language used in programming and designed for managing data held in a relational database management system, or for stream processing in a relational data stream management system [12].
Version Control System	It is a system to manage changes by recording and tracking any changes in a file. It enables developers to monitor the history of any applied changes and retrieve data in the case of needed [14] [15].

4. Testing Results

4.1. Test Results generated by tools

Results generated for different pages of the website are listed below in Table 5.

Table 6. Results of the Tools used in Testing

Tool Name	Result
W3C Markup Validation Service	This tool found over 30 validation warnings or errors in each of the pages of our website. They were mainly due to typos or the use of deprecated HTML tags. We resolved all of those issues and received a perfect score in the final test.
WAVE Tool	This tool found one colour contrast error and label tags errors which are resolved. They were mainly due to button design used with the appropriate icon and not the text itself. It was then resolved as per the rules of WCAG 2.0 (Level AA).
AChecker	This tool found an error in the JavaScript tag and HTML title tag. It generates a pdf report for CSS, HTML, Potential problem, Known problems.
Responsive Test Tool	This Tool was able to find few errors in image responsiveness i.e. On turning the screen perspective of a tablet or a mobile phone, Images were not able to adjust and was creating disorientation in the content page. It was resolved after replacing the px values with percentage values.

4.2. Conclusion for testing

For the accessibility testing, we conclude that we cannot claim for having the 100% accessibility based on the results generated by automated online testing tools. Some level of human intervention (Manual Inspection) is required in order to check the correctness of the accessibility over one's site by following the checklist and guidelines provided for WCAG 2.0 Level AA.

For the responsiveness testing, we conclude that the tool used to test the responsiveness was reliable and with the help of different screen sizes available over that tool, we were able to test efficiently. Also, manual testing was done using several user agents (Mozilla Firefox, Google Chrome, Safari, Opera) to complement the automated testing.

For the validation testing, we used the approach of manual testing as our website did not have any form of credentials to submit and authenticate. So, we generated the most common and frequent error (403, 404, 405, etc) occurring scenarios and validated it.

To avoid privacy breach over design and styling code, access to CSS is blocked and can only be controlled by an administrator.

5. Experiential knowledge

Background/ Area of expertise of each team member is described in brief in Table 6. The diverse knowledge of the different field in Software Industry lead us to think divergently before taking any decision during the implementation of Sestopia.

Table 7. Experiential Knowledge Table

Knowledge Area	Skill	Experiential knowledge
Software Design	User Research and Personas	As a fresher, I was lacking in having sound knowledge in the software design domain. However, in my master's, I was able to gain great exposure to this skill. Studying different courses in Concordia, I learned a lot about Software Requirement Specification, user personas and user research by Interviews, Questionnaires, Observation and Studying Documentation. Having a good knowledge of those concepts, I was able to help in brainstorming and contributing to Sestopia's Web Design.
Software Quality	Conducting Reviews and Audits	I have around 3 years of experience in quality assurance. But I have been a part of a project in which I conducted reviews and audits. I have conducted technical reviews that mostly included inspection and walkthroughs. After working in technical reviews for 2 years, I got involved in management reviews as well, to evaluate actual project results with respect to plans. It included activities like- Achieving the expected results, meeting the organization's requirements, functions in accordance with the established processes.

Software Maintenance	Software Reengineering	My 1 year of work experience from the data science side has not been useful in taking decisions or planning efforts. Currently, I am a freelancer developing hybrid mobile applications, I used my knowledge from this background to give a basic structure and look to the website, even though hybrid mobile app frameworks are similar to website-based languages, some extra efforts were required to understand the implementation. My knowledge of team cooperation and communication was of some use in progressing through and conducting meetings.
Software Engineering Process	Software Process Measurement	I have 2 years of experience in application development but never estimated or measured the complexity of the process or product. Knowing the importance of this skill, I have selected this and gained knowledge about, how to measure the efficiency and effectiveness of various processes and to finish the project within the prescribed time and budget and also ways of measuring the software process, planning the project, measuring the complexities of a project and estimating the development effort etc.
Software Testing	Automated Unit Testing	As a junior software developer, I have about 2 years' experience in developing software as well as a corporation with some software testing development teams for some specific projects in my previous workplace. The projects that I was involved in were about the banking industry and mobile application. Moreover, I have acquired good knowledge and experience in my master's program by performing the project for courses such as Software Maintenance, Advanced Programming Practices.

Software Requirements	Software Requirements Elicitation	Having passed a course in software system requirements, I got familiar with functional and non-functional requirements, and system and software requirements. I also have understood that how goals, domain knowledge, and stakeholders are important in eliciting requirements. I practiced eliciting requirements in different ways in my course project including interviews, scenarios, prototypes, mind mapping, user stories, etc. I also was taught that there are lots of differences between academia and industry and that in the real world, the requirements could be changed later. Also, there are many problems in requirements elicitation in the real world, as the stakeholders may not be able to say clearly what they really want or may omit important information.
Software Management	Scheduling	For 6 months I've been project manager and had to deal with multiple concurrent factors interfering in the activities, including a time creep that forced me to reschedule things to a timestamp smaller than initially stipulated. Knowledge of what was critical, what was good and what was superfluous, not only from the functional perspective but also related to the temporal aspect of requirements, was vital to being successful once things have to be removed/rescheduled without impacting the functionality of the deliverable.
Computing Foundation	Problem Analysis	Having 1 year of software development and integration experience, I have a good knowledge of resolving bugs and few critical integration issues. To resolve it, the development team always has to know the exact cause for that bug or issue before acting upon it. Otherwise, it would

		take a tremendous amount of time and effort to deliver the solution. So, I took this opportunity to gain expertise over Problem Analysis by using my experiential knowledge in this background.

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