

SOEN 6011

SOFTWARE ENGINEERING PROCESSES

SUMMER 2020

Version 1.0

for

SESTOPIA

Prepared by

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SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Table of content

SOFTWARE ENGINEERING PROCESSES	0
Purpose	3
Scope	3
Definitions, acronyms, and abbreviations	3
N/A	3
Product perspective	4
Product functions	4
User characteristics	5
Constraints	5
Assumptions and dependencies	5
Specific requirements	6
External interfaces	6
Functional requirements	10
Actor / goal list	10
Use Case view	11
Non-functional requirements	12
Accessibility	12
Performance efficiency	12
Compatibility	12
Usability	12
Maintainability	12
Portability	12
Design constraints	12
Technologies stack	12
Development Tools	13

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Persistence	13
MySQL has been used to persist the data.	13
Error Handling	13
Analysis Models	16
Software Process	16
Requirements	16
Design	17
Software Architecture	17
CRC DIAGRAM	18
Logo Design	20
Implementation	21
Front End Implementation	21
Back End Implementation	21
Database Design	22
Database Dictionary	23
Verification	26
Unit Testing	26
Maintenance	26
Summary of the used technologies	27
Skill Selection	27
Data Analysis	27
Test Results	31
Unit Test Results	31
WAV Results	31

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Reference

33

1. Introduction

Purpose

This project is about skills desirable of a software engineer to develop proficiency and excel in a particular area in software engineering for the 21 century as given by SWEBOK and/or SWECOM.

Scope

A web-based application has been implemented to provide several skills related to 15 knowledge areas in SEWBOK.

Definitions, acronyms, and abbreviations

N/A

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

2. Overall Description

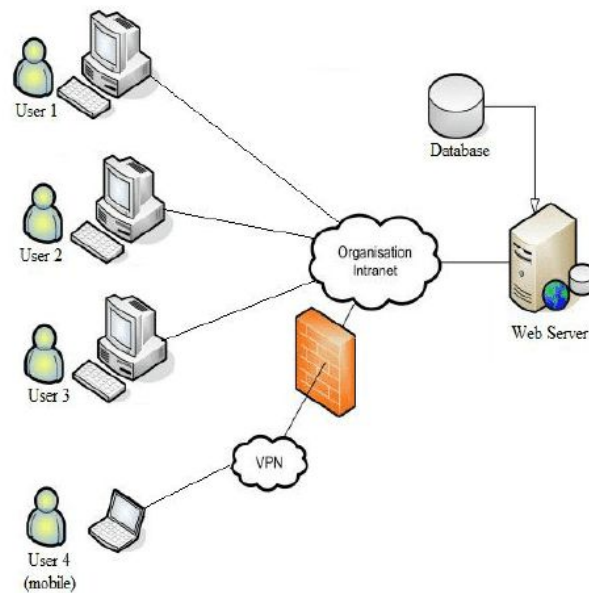


Figure 1. A client-server architecture.

Product perspective

SESTOPIA will be an **information-intensive Web Application**. And it is **navigable and searchable**, and it is accessible to anybody, anywhere.

Also, it is possible to **modify** SESTOPIA easily, and requires a small amount of time and effort by the Administrator.

Product functions

The following are the high-level functionalities which are broken down into specific functions.

Transaction management

- Navigation
- Search

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

User characteristics

There is one type of user in the system.

User Type	Description
User	<p>The User of the system manages:</p> <ul style="list-style-type: none"> • Navigate to any skill • Search content in skills <p>It usually has simple knowledge to use the internet. It means the only skill needed by a user is the ability to browse in the web pages.</p>

Constraints

This is the list of constraints that must be respected.

- The project must be completed by Aug 13.
- The developer team must maintain a relational database management system which is MySQL Database.
- The server-side application must be implemented using the Javascript or PHP
- Front-end must be implemented using HTML, CSS and JS

Assumptions and dependencies

Currently, there are no assumptions or dependencies which affect this project.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

3. Specific requirements

3.1 External interfaces

3.1.2 Design Process

The overall design of the project's website was done in 3 major stages,

Requirements Gathering

Considering the time and duration of the project, the website had the sole purpose to allow for an interface that was flexible to implement efficiently while being curated enough to the idea of the project. Initial requirements were gathered during our weekly meetings within the project group and those were the top requirements that were observed.

- The website must support multiple members showing their individual skills
- The website must have a simplified interface to attain to modern web standards
- A universal page showcasing the members of the team should be present in the website

Mind Mapping and roles designations helped with structuring the requirements for the project and allow the design process to be more streamlined for the iteration process

Wireframing and Design Iterations

After gathering the basic requirements, multiple design iterations were conceptualized and discussed within the team via a design review system to nail down a design that was visually satisfying and resonated with the project's goals.

We utilized an agile task based system to keep track of design goals and remind ourselves the priorities of the project goals in general

From the start of the project, uniformity/ consistency in design was a top requirement for us. It was the view of our team to have a webapp that was consistent in design through the content of our members, allowing the users of our website to have a friendly User Experience as we gauged this goal via the helpful idea of user personification, which in this case was a "University professor",

This allowed us to understand what a professor would want to see in a web site such as this and based our design and visual choices according to that.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Figure 2 shows so of the design methodologies and visual choices that were used in the making of the web app

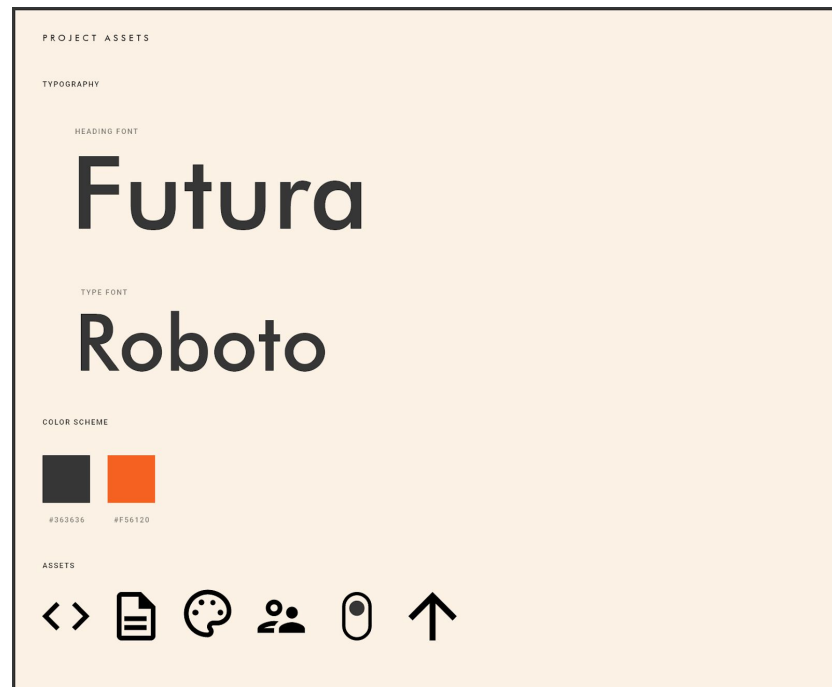


Figure 2 Project Stylesheet

As a brief overview of some of the design screens, **Figures 3,4,5** Show some of the main screens of our web application in terms of visual design and User Experience.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13



Figure 3. Main Screen (Home page)



Figure 4. Individual Member page (Home page)

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13



Figure 5. About (Home page)

Developer handoff

After the design of the project was initiated and decided upon, to make sure the developers of the projects had all of the assets available to them in real time, a mini design repository was hosted using third party cloud servers which updated in real time to the changes that the designer made, allow the developers to stay on top of the design changes made and update their implementation accordingly.

Furthermore, The server also allowed for a single point of contact for design assets and typographic elements which lead to increased implementation efficiency.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

3.2 Functional requirements

3.2.1 Actor / goal list

Actor	Goal
User	01. Navigate through all Skills 02. Search contents in all skills.
Administrator (server side)	01. Add new Skill 02. Modify existing Skill 03. Delete existing Skill

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

3.2.2 Use Case view

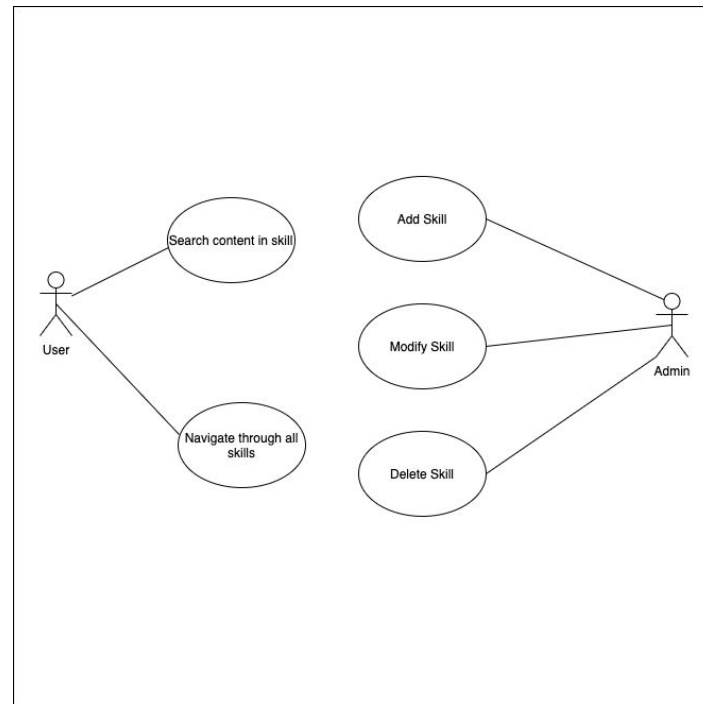


Figure 6. Use case model.

Search Content in Skill : User shall search content in skills

Navigate through all skills : user shall navigate through all skills.

Add Skill : Admin shall add skill from the server side.

Modify Skill : Admin shall modify skill from the server side

Delete Skill : Admin shall delete skill from the server side

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

3.3 Non-functional requirements

3.3.1 Accessibility

The web application has been deployed and it is available to anybody, anywhere, using any interactive device connected to the Internet

The web address is <http://www.baiyuhuo.com/sestopia>

the website also has been tested for accessibility on the following website <https://wave.webaim.org/>

3.3.2 Performance efficiency

Appropriate architectural style that support quality characteristics like separation of concerns, modularity, reusability and adaptability.

3.3.3 Compatibility

Compatibility testing will be used to ensure compatibility of the web application with various other objects such as browsers.

3.3.4 Usability

Designing an interface that will be easy to learn. The interface will be easy to navigate through all the skills.

3.3.5 Maintainability

Identifying exceptions or faults, debug or isolate faults, in this project maintenance can be done during testing and overiewing iteration.

3.3.6 Portability

The web application can be run on both windows and linux; and shall run on all computer web browser

3.3.7 Design constraints

Technologies stack

- Frontend: HTML, CSS, JavaScript.
- Backend: JavaScript or PHP
- Database: MySQL (Optional).

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Development Tools

- Visual Studio Code
- Navicat 8.0
- MySQL WorkBench
- Chrome
- Postman

3.3.8 Persistence

MySQL has been used to persist the data.

3.3.9 Error Handling

We also put the error handling and fault tolerance into the consideration. There are three types of errors that have been handled by SESTOPIA.

Global Resource Not Found Error

We handle all the unavailable resources on our server end, we have a customized 404 page with proper guidance for guiding users back to the index page.

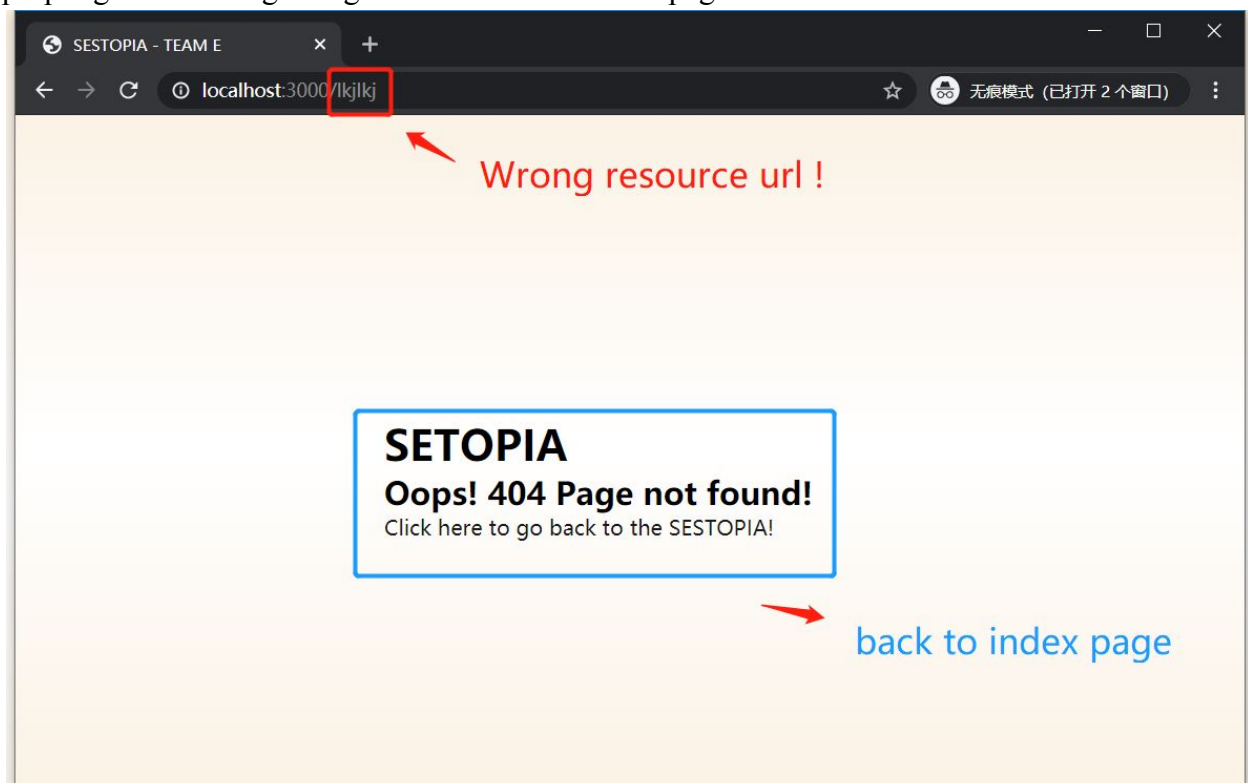


Figure 7.. SESTOPIA 404 page

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Service Error

The database is where we persist our data, so it is of great importance to make our data consistent all the time. We have handled all possible errors that might be thrown by the database operation object and convert it into user-friendly messages with unique code to locate the bugs for maintainers then send it back to the frontend.

```

ERROR: {
  DB_CONNECT_FAIL: {
    CODE: 501,
    MSG: 'Can\'t connect to the database, please contact the administrator!',
  },
  DB_ERR_MEMBER_GET: {
    CODE: 511,
    MSG: 'Can\'t get member information, please contact the administrator!',
  },
  DB_ERR_MEMBER_ADD: {
    CODE: 512,
    MSG: 'Can\'t add new member, due to following issue: ',
  },
  DB_ERR_SKILL_GET: {
    CODE: 521,
    MSG: 'Can\'t get skill information, please contact the administrator!',
  },
  DB_ERR_SKILL_ADD: {
    CODE: 522,
    MSG: 'Can\'t add new skill, due to following issue: ',
  },
}

```

Figure 8. Database Error Message Snapshot

Input Validation

We also handed input validation to prevent improperly formed data from entering an information system. Because it is difficult to detect a malicious user who is trying to attack software, applications should check and validate all input entered into a system. In this case, the search function not allows user to input special symbols such as ‘**&@!#%^..’.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

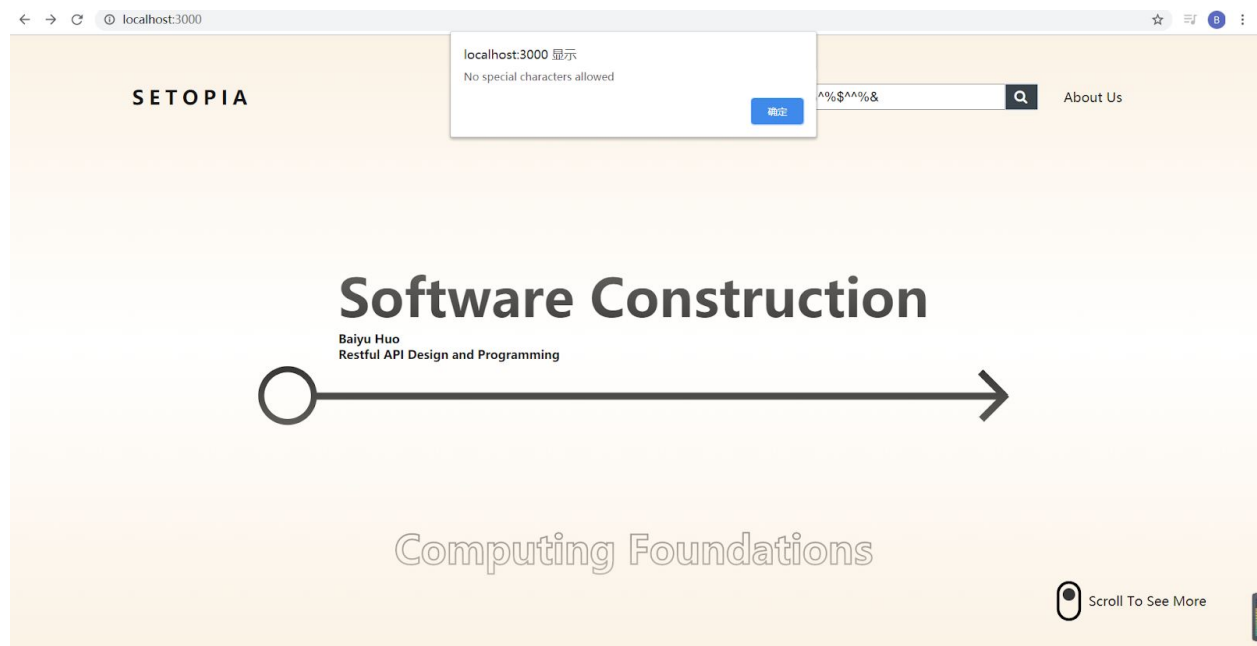


Figure 9. Input validation

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

4. Analysis Models

4.1 Software Process

Agile Methodologies has been used to develop the web application



Figure 10. Agile Model.

4.1.1 Requirements

Requirements elicitation has been done in the first two weeks through reading the project description, asking professor and TA.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

4.1.2 Design

4.1.2.1 Software Architecture

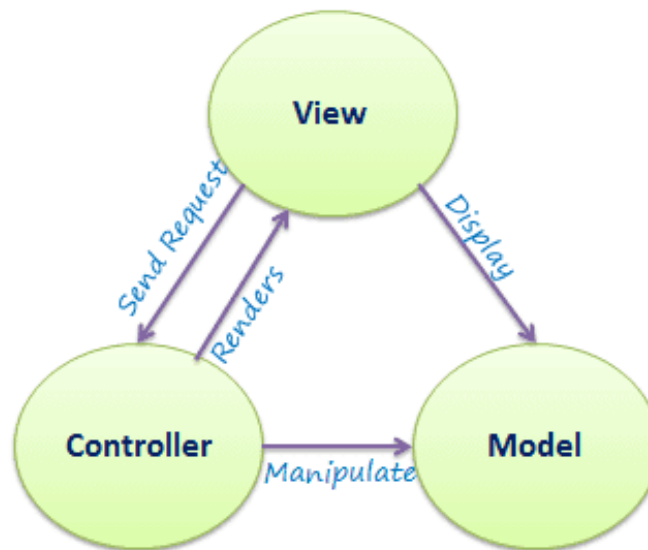


Figure 11. MVC Model.

The use of MVC components improves **maintainability**

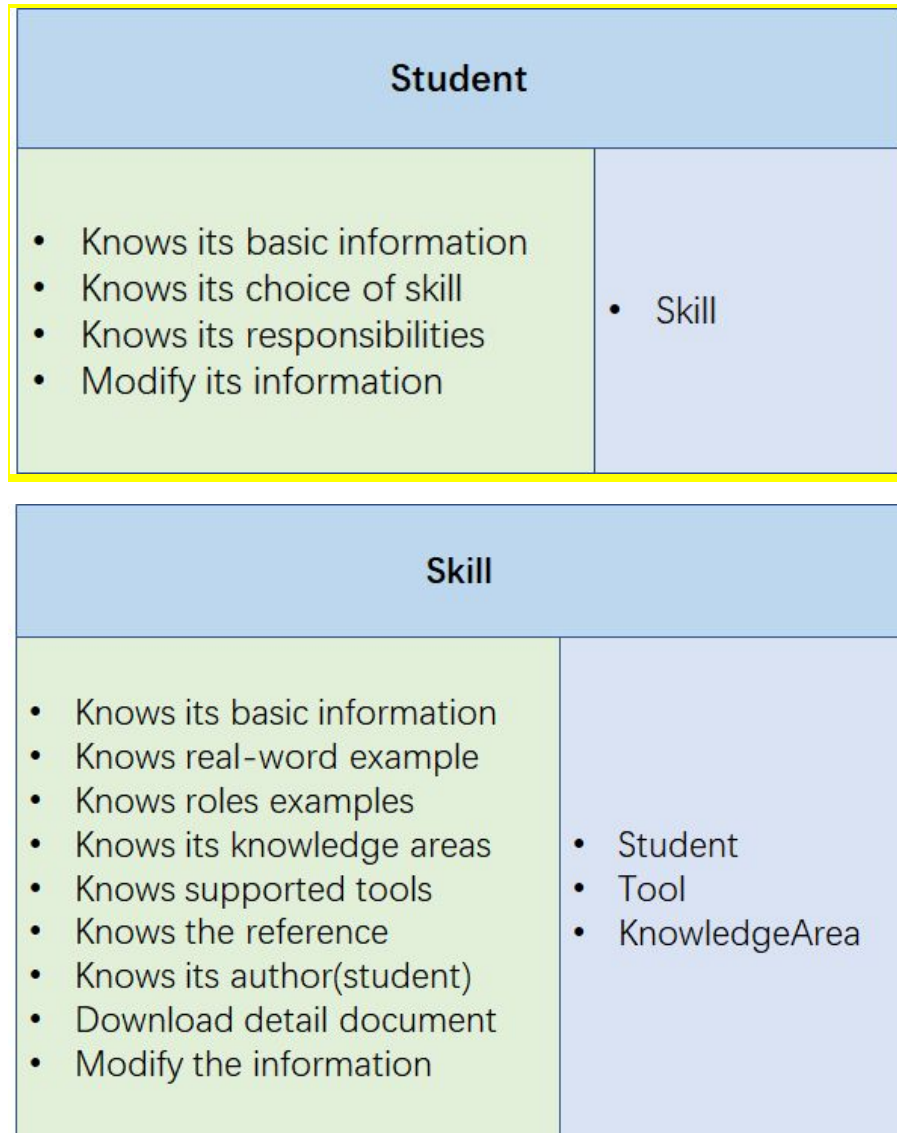
A decomposition of the system into three components:

- A model containing the core functionality and data,
- Views displaying information to the user, and
- Controllers that handle user input (Search and navigation).

Another option that can be used is to use a static website, however this approach isn't the best practice for maintainability.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

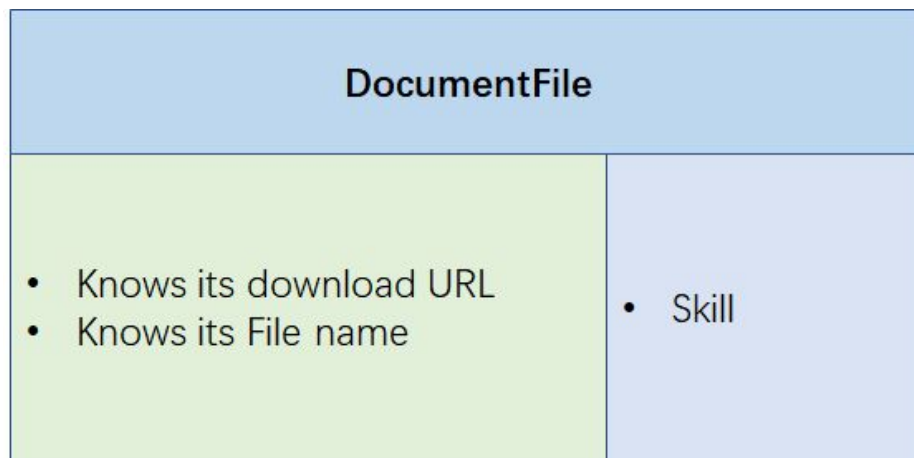
4.1.2.2 CRC DIAGRAM



SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

KnowledgeArea	
<ul style="list-style-type: none"> • Knows its name • Knows its rationale 	<ul style="list-style-type: none"> • Skill
Tool	
<ul style="list-style-type: none"> • Knows its name • Knows its description 	<ul style="list-style-type: none"> • Skill
SerachProxy	
<ul style="list-style-type: none"> • Search by student's name • Search by knowledge area • Search by skill's name • Blurt search 	<ul style="list-style-type: none"> • Student • Skill

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13



4.1.2.3 Logo Design

Available tools to design logo

A logo is an integral part of every company that spreads its message to the prospects and clients. It aims to convey brands, companies and event information to prospective clients easily, efficiently and effectively. If you wanted a great logo design for your event or company a few years ago, you will certainly be finding the logo designers' support.

Today, however, without the assistance of an expert, you can design your own logo, using incredible applications to create reliable and efficient logos..Here are 10 top tools for making logo according to their popularities:Adobe Illustrator, Tailor brands, Corel Draw, Logoist, Logomaker, Laughingbird, Logo Design Studio Pro, LogoYes, Sothink, Designhill

Tool that has been used

Among a lot of options available in the market for designing logos , I decided to use CorelDRAW for “SESTOPIA” .Along with familiarity with this tool , it is compatible with Scalable Vector Graphics format (SVG) which was essential for us to use in the design of our website to support interactivity. CorelDRAW is a vector graphics editor developed by Corel Corporation. It is programmed to edit pictures in two dimensions, including logos and posters. It is also the name of the Corel graphics suite which includes bitmap-image editor Corel Photo-Paint and other graphics-related programs. It was initially released in 1989 and the new version was released in March 2020 and is branded as CorelDraw Graphics Suite 2020 .

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Reason behind doing the logo that

In order to design a logo for “SETOPIA” ,We tried to follow simplicity and modernity . We needed a symbol that represents our website’s personality as well as highlighting the idea of its design through the simplest image possible.

4.1.3 Implementation

4.1.3.1 Front End Implementation

Available Technologies in the market

Coffee script, HTML, CSS, SCSS, LESS, jQuery, Javascript, Pug, ReactJs, AngularJs, Vue.js

Technologies used

Java Script, JQuery, HTML, CSS, Splide library

Reason to use that Technology

HTML: to structuring web pages(required)

CSS: to style the web pages. Css is the s

JavaScript and JQuery: help manage the page functionality, including creating dynamic pages.

Splide library: a lightweight library(14kb) to manage sliders.

4.1.3.2 Back End Implementation

Available Technologies in the market

Laravel framework, Node.JS, Express, Mysql, Oracle

Technologies used

Node.JS, Express, Mysql

Reason behind using that technology

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Laravel framework is based on PHP and MVC architecture. however it is a new technology for most of us and it will take time to learn it as it is a bit complicated and given the time constraints (taken into accounts summer semester is only 6.5 weeks) we have decided to stuck with a technology that we already know like Node.JS so we can minimize the risk and complete the project on time.

System components design

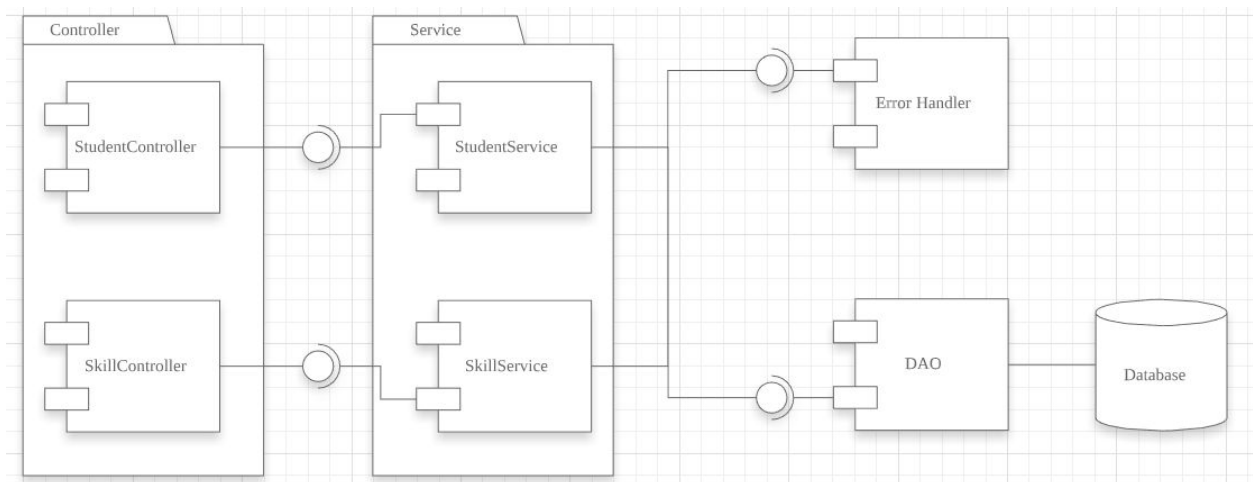


Fig 12. SESTOPIA Component Diagram

The backend of SESTOPIA has been divided into multiple layers so that each of the layers will be responsible for different responsibilities. It aims to separate of concern and also keeps the code structure neat and clean. On top of that, the functions have been modularized based on the responsibility and rationale. Our objective is to make SESTOPIA a maintainable, extensible project.

4.1.3.3 Database Design

SESTOPIA uses Mysql 5.6 to persist the data for the system. The data design followed 3rd NF(Third Normal Form) to reduce the duplication of data, avoid data anomalies, ensure referential integrity, and simplify data management. Detail design see Fig.5 ER-Diagram

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

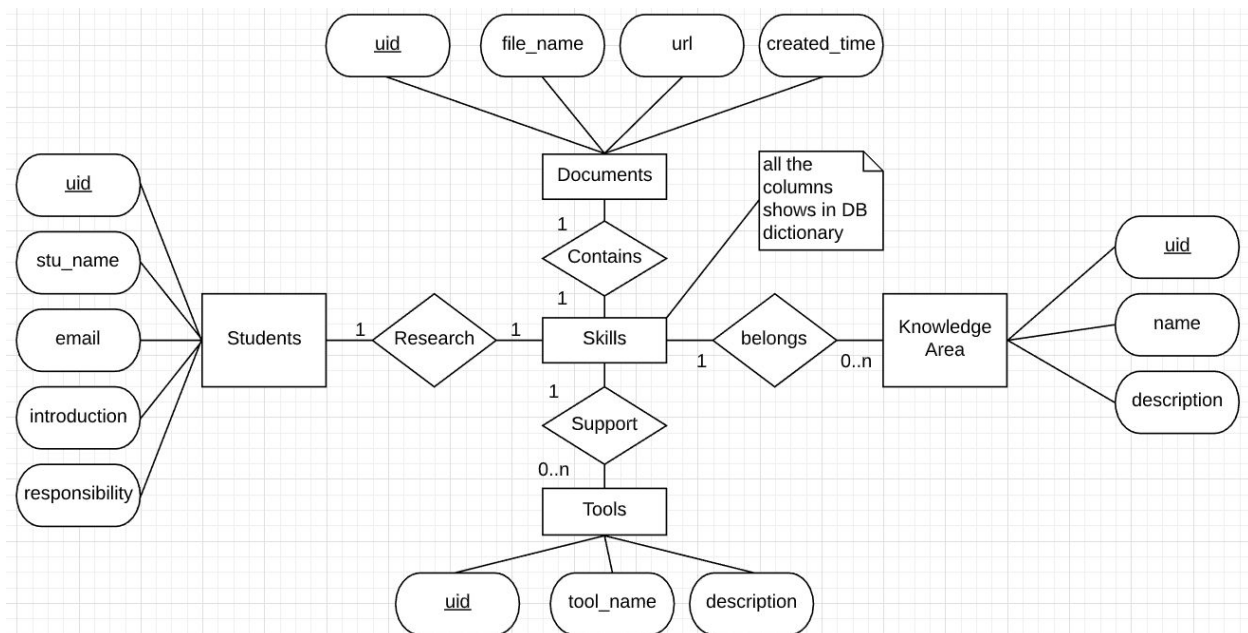


Fig 13. SESTOPIA ER-Diagram

4.1.3.4 Database Dictionary

T-01 Student

Field Name	Data Type	Size	Constrain	Description
id	number	8	primary key	unique id, auto increment
name	varchar	150	not null	student's name
student_id	number	8	not null	student's number
email	varchar	255		email address
gender	char	1	not null	1: male 0: female
introduction	text	n/a		self-introduction
responsibility	char	4	not null	representation for responsibilities
skill_id	number	8	foreign key	student's skill choice

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

T-02 Skills

Field Name	Data Type	Size	Constrain	Description
id	number	8	primary key	unique id, auto increment
name	varchar	150	not null	skill's name
classification	text	n/a		document's content for classification of skill
prerequisites	text	n/a		prerequisites for the skill
knowledge_area	number	5	foreign key	knowledge area
rationale	text	n/a		rationale of the skill
roles_for_skill	text	n/a		roles
related_activities	text	n/a		related work
real_world_scenario	text	n/a		real work example for the skill
role_of_academia	text	n/a		how academia and industry help to learn the skill
tools	number	4	foreign key	supported tools
self_assessment	text	n/a		student self-evaluation
reference	text	n/a		list of references
download	number	4	foreign key	document file info
related_area	text	n/a		related software knowledge area

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

introduction	text	n/a		introduction of the skill
--------------	------	-----	--	---------------------------

T-03 Documents

Field Name	Data Type	Size	Constrain	Description
id	number	8	primary key	unique id, auto increment
file_name	varchar	150	not null	file name
url	varchar	255	not null	file download url
created_time	datetime			create time

T-04 Tools

Field Name	Data Type	Size	Constrain	Description
id	number	8	primary key	unique id, auto increment
tool_name	varchar	150	not null	tool name
description	varchar	255		tool's introduction

T-05 Knowledge_Area

Field Name	Data Type	Size	Constrain	Description
id	number	8	primary key	unique id, auto increment
name	varchar	150	not null	knowledge name
description	varchar	255		knowledge introduction

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

4.1.4 Verification

4.1.4.1 Unit Testing

Unit testing is an essential part of a software developer. It is mandatory to write the unit test to get confidence when we change the code later either for maintenance or refactoring or adding more functionality.

Mocha has been used to test the backend

4.1.4.2 Acceptance Testing

Test Scenarios for testing the functionality of the web application:

Pre-condition: Users should be able to access the internet.

Test 1: Product Details, verify if a User is able to:

- View all the skill titles on the web page
- Navigate to the skills
- View all the sub-sections in the skill details page

Test 2: Search content:

- User is able to search any content
- Navigate to the corresponding skills

4.1.4.3 Code Standard Validation

- ESLint
 - The Javascript code style is restricted and follows a unified standard among the team, we have already defined a list of code standard verification.
- WCAG 2.0 Level AA
 - SESTOPIA is implemented following WCAG 2.0 Level AA Standard to make our website more accessible.

4.1.5 Maintenance

The system can be maintained easily because of the software architecture that has been used.

There is a Low coupling between layers (Model, View and Controller) and persistence data is in a separate layer.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Data can be easily maintained from the server side by the administrator. Administrators can add new skills and add new members at any given time.

5. Summary of the used technologies

Frontend: HTML, CSS, Javascript

Backend: Node.JS, Express

Validation: Eslint

Database: Mysql 5.6

Test: Mocha

Version Control: Github

6. Skill Selection

6.1 Data Analysis

Data analysis is one of the fundamental skills for software process improvement and helps analysts to make decisions on process improvement and behavior prediction, increasing profitability and drive effective decision-making.

Collecting and analyzing data from your software processes will begin to reveal some unexpected insights that can be used for improving processes and increase efficiency. Data analysis as an internal arrangement function done by data analysts is a great skill that presents numbers and figures to management, it involves a more detailed approach in recording, analyzing, disseminating and presenting data in a way that is easy to interpret and make better decisions for the business.

6.2 User Interface Design

There are a couple of rationales that can be explored for the need for human empathy in UX Designing. Some of these reasons were explored in the introduction of this report however, for the sake of dept into the topic, more details will be discussed in this section going forward.

6.3 User Acceptance Testing

A. Business Interest

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

UAT is important because it helps demonstrate that required business functions are operating in a manner suited to real-world circumstances and usage. If the expected outcome is not achieved during testing, it will be sent back to the developers for repair. This process helps to make sure the developed product is well built. just because UAT is the final test conducted before production.

B. Personal Interest

The main reason for selecting that skill is because I would like to gain some experience in testing field as I'm about to get graduated and I would like to work in that field.

6.4 Algorithm Design and Complexity Analysis.

Algorithm Analysis is the most important step for software development. It concerns "understanding" why and what the system does . No one can set an algorithm without profound understanding of the problem and its solution.

Algorithm Analysis is done before coding. It is important to be able to measure, or at least make educated statements about, the space and time complexity of an algorithm. This will allow us to compare the merits of two alternative approaches to a problem we need to solve, and also to determine whether a proposed solution will meet required resource constraints before we invest money and time coding. This is the reason I choose the “Algorithm Design and Complexity Analysis” skill.

6.5 Restful API Programming

Restful API programming is one of most popular concepts in modern web application and it is of great importance. It provides a great deal of flexibility. Data is not tied to resources or methods, so REST can handle multiple types of calls, return different data formats and even change structurally with the correct implementation of hypermedia. The REST style architecture is also famous for its scalability which is one of the most important concerns in a large project.

REST architecture style and RESTful APIs now considered as one of the most popular Web application skills in the market. It generally becomes a really essential skill for web developers.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

6.6 Communication Skill in software project management

Effective communication, if not the most, is one of the most important skills for a software developer. Generally, it is important to be able to communicate with different stakeholders as not being able to communicate well can have catastrophic results. For instance if a software developer has a different understanding of a requirement than the customer and they don't communicate well, there could result in bugs that can be very expensive. This study[14] illustrates the role of effective communication for a software developer. They named communication skills as important as technical skills for a software engineer career development.

As mentioned in the introduction, the Software Engineering Professional Practice area is naming written writing, reading, presentation and team communication as important communication skills. In this section we investigate each of these skills and justify the rationale

Writing:

Wikipedia defines technical writing as:

Definition: Technical writing is writing or drafting technical communication used in technical and occupational fields, such as computer hardware and software, engineering, chemistry, aeronautics, robotics, finance, medical, consumer electronics, biotechnology, and forestry.[15]

computer.org(IEEE computer society) defines technical writing as:

Definition: Technical writing is a form of communication that attempts to take a technical field (like programming or software development) and convey ideas from that field as efficiently as possible, sometimes to other experts, and sometimes to non-experts.[16]

The document emphasises that technical writing is infact a type of traditional writing but there is a distinction due to the specialized or technical words. This emphasizes the need to be familiar with basic knowledge of software engineering and computer science.

Reading:

Wikipedia defines reading as:

Definition: Reading is the complex cognitive process of decoding symbols to derive meaning.

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Reading is an essential part of communication in software project management. Managers must have reading skills as it improves their management style. Reading efficiently will increase both the amount of knowledge that a person can acquire and also the retention of the acquired

knowledge[17]. There are several techniques that can increase the quality of reading. Among them, speed reading techniques are shown to be effective in both speed and comprehension. [18]

Presentation:

In the university of british columbia wiki page, presentation skills defines as:

Definition: the skills you need in delivering effective and engaging presentations to a variety of audiences. [19]

A software project manager is presenting many parts of the project to different team members. This can be a small feature discussion or whole project presentation for a client. It is important to follow the important criterias to perform well in a presentation. A good presentation can help for others to understand you better.

team communication:

Wikipedia defines teamwork as:

Definition: Teamwork is the collaborative effort of a group to achieve a common goal or to complete a task in the most effective and efficient way.[20]

Team communication is a part of team work. This skill is for a software project manager who needs to improve the connection between team members.

6.7 Proficiency in distributed version control system

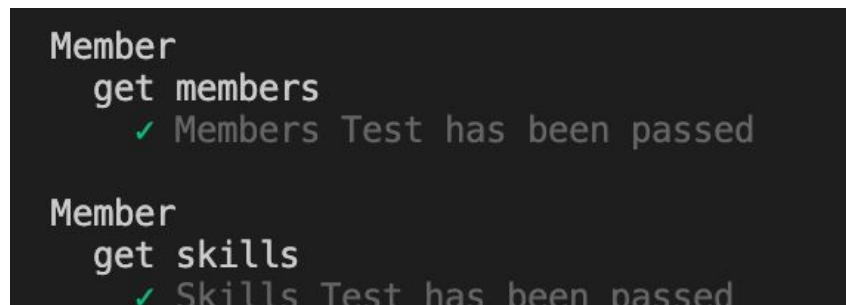
Tracking changes during software development requires that the collaborating team members have a workflow when committing changes to the central repository to avoid merge conflicts. The DVCS offers a different model of workflow to manage collaboration, some are heavily focused on branching patterns, and others are repository oriented.

In Devops, DVCS ensures that dependency issues encountered by modern containerized applications are avoided. This is achieved because DVCS offers traceability and visibility into changes made to code .

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

7. Test Results

7.1 Unit Test Results



```

Member
  get members
    ✓ Members Test has been passed

Member
  get skills
    ✓ Skills Test has been passed

```

Figure 14. Test Results captured from Visual Studio Code.

7.2 WAV Results

Perceivable

Non-text Content: provided alt tag for images, appropriate iframe titles

Info and Relationships: semantic markup, table structures, meaningful title for tags

Meaningful Sequence: logical navigation in member's page

Orientation: orientation of the web content is not specific.

Use of Color: colors are not the only method to convey content (there are icons, animation and error handling), links are distinguished and change when hover,

Visual Presentation: not fully justified, adequate line and paragraph size, specified background color, does not require horizontal scrolling when the size doubled.

Non-text Contrast: contrast rate of 3:1 for objects and other user interface components,

Operable

Keyboard: site functionality is also available with keyboard

No Timing: no time limit for site pages.

Page Titled: descriptive page title for all pages

Link Purpose (In Context): distinguished linked with proper text and title.

Focus Visible: current keyboard focus is visual in page.

Section Headings: section headings using heading tags properly

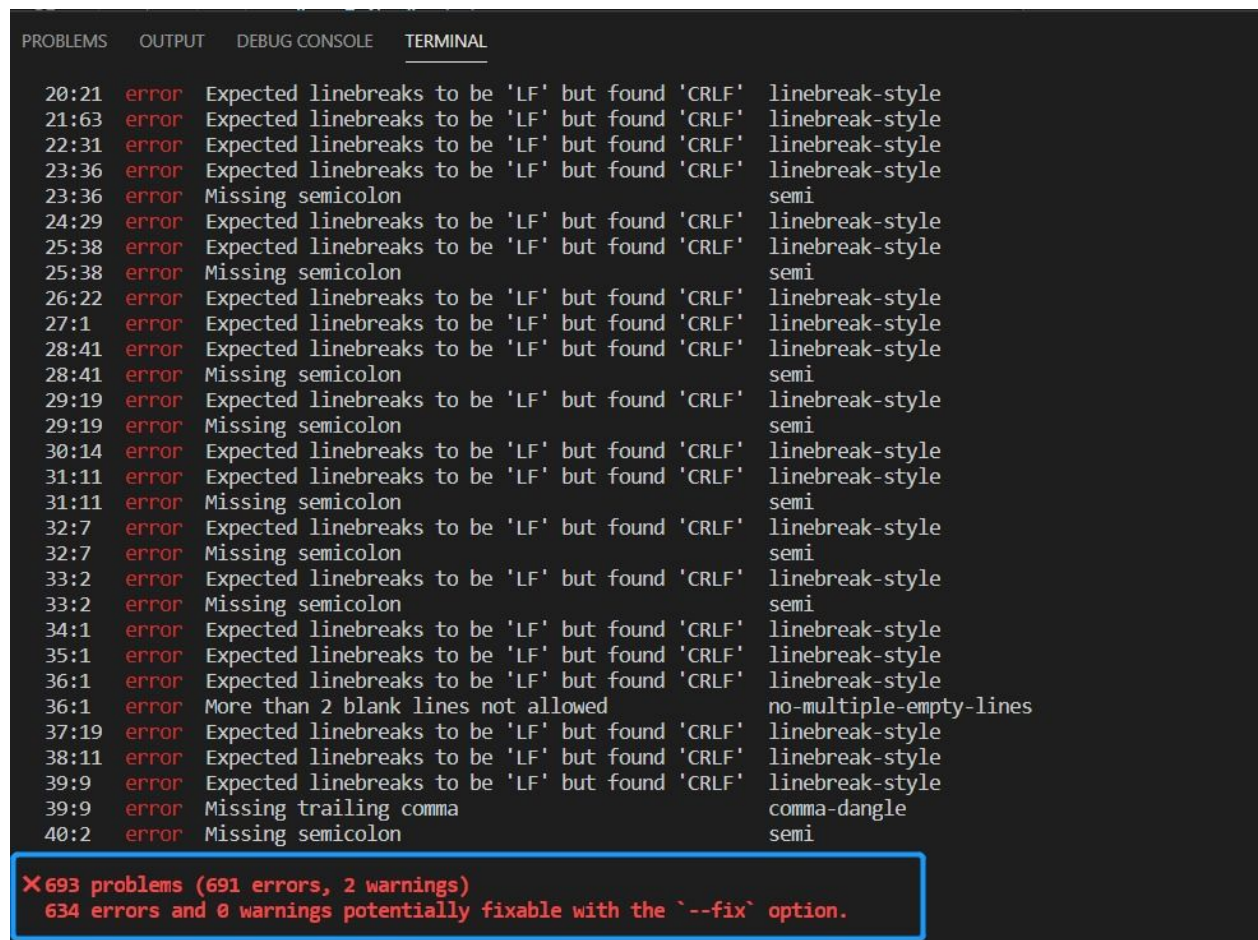
Label in Name: appropriate text, accessible name and visible names are provided

Understandable

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

Language of Page: language tags provided
Error Identification: searchbox validates the input
Error Suggestion: proper error suggestion.

Lint Results



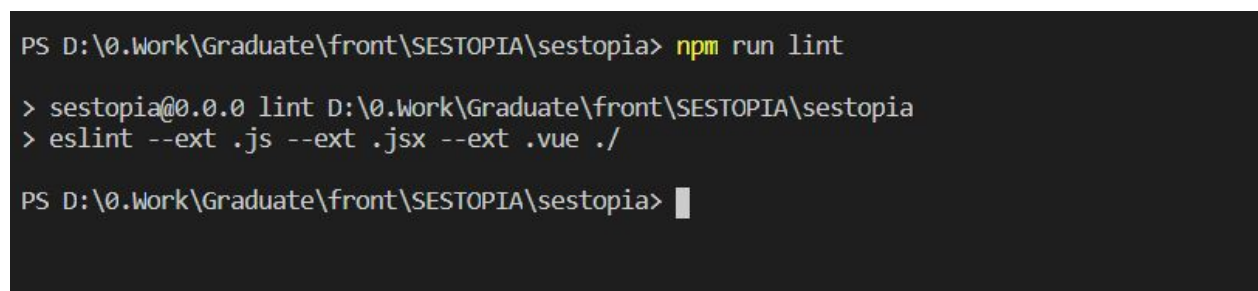
```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL
20:21 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
21:63 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
22:31 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
23:36 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
23:36 error Missing semicolon semi
24:29 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
25:38 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
25:38 error Missing semicolon semi
26:22 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
27:1 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
28:41 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
28:41 error Missing semicolon semi
29:19 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
29:19 error Missing semicolon semi
30:14 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
31:11 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
31:11 error Missing semicolon semi
32:7 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
32:7 error Missing semicolon semi
33:2 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
33:2 error Missing semicolon semi
34:1 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
35:1 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
36:1 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
36:1 error More than 2 blank lines not allowed no-multiple-empty-lines
37:19 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
38:11 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
39:9 error Expected linebreaks to be 'LF' but found 'CRLF' linebreak-style
39:9 error Missing trailing comma comma-dangle
40:2 error Missing semicolon semi

X693 problems (691 errors, 2 warnings)
634 errors and 0 warnings potentially fixable with the --fix option.

```

Figure 15. ESLint result (Before)



```

PS D:\0.Work\Graduate\front\SESTOPIA\sestopia> npm run lint
> sestopia@0.0.0 lint D:\0.Work\Graduate\front\SESTOPIA\sestopia
> eslint --ext .js --ext .jsx --ext .vue ./

PS D:\0.Work\Graduate\front\SESTOPIA\sestopia>

```

Figure 16. ESLint result (After 0 Error, 0 Warning)

SESTOPIA	Version: 1.0
Software Engineering Process	Date: 2020.08.13

8. Reference

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