

Florida International University
School of Computing and Information Sciences

Software Engineering Focus

FINAL DELIVERABLE

Project Title: EnvoScholar v2.0

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Abstract

This document presents the information required for a thorough understanding of the academic search engine of EnvoScholar. This academic search engine is specifically for researchers in the field of environmental science to search through, and save, and provide feedback for environmental peer reviewed articles. Users are able to create profiles so they can save articles and gain access to view their saved articles, along with their search history and click history. Users can leave feedback on the overall user experience and can also browse the ENVO ontology using two visualization techniques, a treeview and node graph structure. This is version 2.0 of EnvoScholar, therefore, this document will specifically talk about features that were added to this web application. This document will contain the user stories that were completed, the user stories that were not completed, the project plan, the system design, and the system validation. With the information provided in the document, one will be able to understand how EnvoScholar works with its various components and gain an idea of future plans with EnvoScholar.

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1 INTRODUCTION

Environmental scientists conduct research in their fields using tools such as academic search engines such as Google Scholar or Academic.edu. They rely on these search engines to help them find the cutting edge work in their field, however, the existing systems are not dedicated to environmental science papers. They contain peer-reviewed articles in all research fields from medicine to computer science, and more. As a result, EnvoScholar was created to be an academic search engine specifically for researchers in the field of environmental science to search through, and save, and provide feedback for environmental peer reviewed articles. Users are able to create profiles so they can save articles and gain access to view their saved articles, along with their search history and click history. Users can leave feedback on the overall user experience and can also browse the ENVO ontology using two visualization techniques, a treeview and node graph structure. This is the second version of EnvoScholar, therefore, this section will briefly mention the first version and then will elaborate specifically about features that were added to this web application. With the information provided in the document, one will be able to understand how EnvoScholar works with its various components and gain an idea of future plans with EnvoScholar.

1.1 Current System

EnvoScholar was built using Angular 6 for the front end, NodeJS and Express as a server for the MongoDB which contains the user profiles and feedback space, and PostgreSQL which contains the articles. The header bar on each page contains a link called Ontology to a page which has a visualization using a treeview and node graph view from an external widget which connects to the environment ontology. The current system allows any user, whether signed in or not, to enter a search. When a search is submitted, the user will be redirected to a page, which displays articles related to the search entry.

On that page, the user is able to do a variety of actions. They will be listed below as follows:

- The user can click on any article title to be redirected to a page with more information on the article.
- For each article, the user can click on View PDF to open a new tab with the Science Direct page that contains the PDF of that article.
- For each article and if a user is logged into their account, the user can click on Save to save that article to their profile.
- For each article, the user can click on Share to share the article across social media.

- Towards the top of the page, the user can select from a set of related concepts to see the result results of that specific concept.
- On this page only, the user is able to leave feedback on the overall user experience by clicking on the Feedback button towards the top of the page.
- The user can click on View Results in Microsoft Academic or View Results in Semantic Scholar to cross compare the search they have entered with results from those other search engines.
- The user can sort the results by relevance or most recent, and filter based on the published date.

Once the user browses to a specific article, they are taken to a page which shows the similar options with the View PDF, Save, Share, and Cite button along with the abstract of that article. The page also displays a list of citations which are not in the database yet so there is dummy text shown. The last features that were added to first version are related to users and their accounts. Users are able to create an account by clicking on the Account button on any page. They are redirected to the Login page where they can either sign in if they already have an account or sign up if they do not. Once a user signs into their account, they can view their user profile. In the user profile, the user can view any articles that they have saved, view any articles they have clicked on (whether saved or not), and view their search history.

1.2 Purpose of New System

With the second iteration of EnvoScholar, the technologies used remain the same but with more testing across multiple operating systems, not just MacOS. Initially, on the homepage, the search bar now contains an autocomplete features with the concepts from the environmental field to assist in the query search. The main and greatest change that was made from the first version of EnvoScholar is that we implemented our own "in-house" version of the visualization widgets on the Ontology page. This implementation was created using the most up-to-date OWL and OBO versions of the ENVO ontology. Creating our own version of these widgets allowed for extra capabilities to be added to these visualization techniques, such as a more dynamic search and a unification of the two techniques such that if you make a change on one, the same ontology relationships are reflected in the other.

Aside from creating those ontology visualizations from scratch, we also improved the feedback feature by allowing users to rate using an up arrow or a down arrow on each article in the display results page for users to later (not in this iteration of EnvoScholar) have the option to rank their

articles based on this rating. The users also have an added page in their profile which allows them to see the articles which they liked and disliked which is useful for researchers everywhere. On the individual article information page, we added a visualization of text feature. With this feature, the researchers see a list of concepts related to the selected article and upon clicking the concept, the sentences where that concept exists is highlighted. We also addressed a few bugs with the past system, such as a template for the navigation bar and footer so they are the same across all pages, or improving the user interface and user experience when pressing the Save and Share buttons.

2 USER STORIES

The following section provides the detailed user stories that were implemented and the ones that may be considered for future development. These user stories serve as the basis for the implementation of the ontology visualization and an improvement of the current system.

- NVOS-10 Visualization of Text
 - As a user, I would like a visualization of text which highlights the sentences in which a selected concept is located in the abstract description of the selected article.
- NVOS-34 Article Feedback
 - As a user, I would like to leave feedback (up-vote or down-vote) on every article so that I can re-rank articles based on the article feedback.
- NVOS-47 Tree Visualization
 - As a user, I would like a visualization technique using a tree structure so that I could properly browse the ENVO ontology terms concepts, and their corresponding descriptions.
- NVOS-48 Graph Node Visualization
 - As a user, I want to be able to visualize the environment ontology in an node graph format so that I can browse and learn more about the concepts in the ENVO ontology and incorporate them into my search queries.
- NVOS-64 Dynamic Search in Tree
 - As a user, I would like a dynamic search which shows me the ontology treeview containing the concepts and their relationships as I hover over various concepts.

- NVOS-70 Unifying Visualization
 - As a user, I would like to see both the treeview and the node graph view of the ontology on the same page so that I can use both visualizations concurrently for ontology browsing.
- NVOS-71 Enhance Treeview Search Results
 - As a user, I would like a dynamic search which shows me to search through concepts and see their labels first with their identification numbers below the labels. Also, a scroll bar to view more than 15 terms at a time.
- NVOS-72 Node Graph Search
 - As a user, I would like to be able to search concepts in the ontology so that I can see specific concepts in the node graph visualization and further explore concepts in the ontology.
- NVOS-87 Autocomplete Search
 - As a user, I would like an autocomplete feature in the homepage so that I am given suggestions on terms to look for related to environmental research articles.
- NVOS-97 Feedback History Page
 - As a user, I would like to be able to see the articles I have rated so that I can see which ones are helpful for me later on.

2.1 Implemented User Stories

[NVOS-10] Visualization of Text

- **Description:** As a user, I would like a visualization of text which highlights the sentences in which a selected concept is located in the abstract description of the selected article.
- **Acceptance Criteria:** The user should be able to select a concept and see the highlighted sentences which contain that concept.
- **Use Case:**
 - **Name:** NVOS-10
 - **Actor** User

- **Preconditions:** Application must be accessible from a web browser.
- **Description <Flow of events>:**
 - * User should see a list of concepts relevant to the semantic meaning of the article.
 - * User should be able to click on any of the concepts listed and see the sentences which contains that concept highlighted.

[NVOS-34] Article Feedback

- **Description:** As a user, I would like to leave feedback (up-vote or down-vote) on every article so that I can re-rank articles based on the article feedback.
- **Acceptance Criteria:**
 - User can press up or down arrow to specify if article is helpful or not.
 - User can see the rating for the article from profile page.
 - Overall rate of the article is stored in MongoDB for administrators to see.
- **Use Case:**
 - **Name:** NVOS-34
 - **Actor** User
 - **Preconditions:** User must be able to search for articles and results page must be displayed.
 - **Description <Flow of events>:**
 - * User enters a search query in the homepage.
 - * Results are displayed and each article displays up and down arrow to allow feedback.
 - * User press either arrow to express whether article is helpful or not.
 - * Feedback count is updated accordingly in the database.

[NVOS-47] Tree Visualization

- **Description:** As a user, I would like a visualization technique using a tree structure so that I could properly browse the ENVO ontology terms concepts, and their corresponding descriptions.
- **Acceptance Criteria:**

- The user should be able to navigate to the tree visual from the homepage.
 - The user should be able to easily navigate through the tree.
- **Use Case:**
 - **Name:** NVOS-47
 - **Actor** User
 - **Preconditions:** Application must be on accessible from a web browser.
 - **Description <Flow of events>:**
 - * User should be able to see a list of terms from the ontology.
 - * User should be able to see an expandable, dynamic tree.
 - * User should be able to view details and relationships between different concepts.
- ### [NVOS-48] Graph Node Visualization
- **Description:** As a user, I want to be able to visualize the environment ontology in an node graph format so that I can browse and learn more about the concepts in the ENVO ontology and incorporate them into my search queries.
 - **Acceptance Criteria:**
 - User can access ontology page.
 - Ontology is displayed in a node graph format displaying nodes (concepts) and edges (relationships among them).
 - Ontology can be browsed and expanded when clicking in a node.
 - On mouse over a node, further information about the concept can be viewed in a tooltip.
 - **Use Case:**
 - **Name:** NVOS-48
 - **Actor** User
 - **Preconditions:** Application must be on accessible from a web browser.
 - **Description <Flow of events>:**
 - * User accesses the web page from a browser.
 - * User clicks on the ontology toggle and selects node graph.

- * Node graph of the ENVO ontology is displayed.
- * User can click in a node to display concepts related to the node.
- * User moves mouse over a node to see more information related to it.

[NVOS-64] Dynamic Search in Tree

- **Description:** As a user, I would like a dynamic search which shows me the ontology treeview containing the concepts and their relationships as I hover over various concepts.
- **Acceptance Criteria:**
 - The user should be able to enter words into a search bar and be shown a list of possible corresponding concepts.
 - The user should be able to hover over any of the concepts from the list and dynamically see the ontology tree.
- **Use Case:**
 - **Name:** NVOS-64
 - **Actor** User
 - **Preconditions:** Application must be on accessible from a web browser.
 - **Description <Flow of events>:**
 - * User should be able to enter a word into the search bar.
 - * User should be able to see a list of possible related terms.
 - * User should be able to hover over each possible related term and dynamically see the corresponding ontology tree.

[NVOS-70] Unifying Visualization

- **Description:** As a user, I would like to see both the treeview and the node graph view of the ontology on the same page so that I can use both visualizations concurrently for ontology browsing.
- **Acceptance Criteria:**
 - The user should be able to see the treeview and the node graph on the same page.
 - The user should be able to navigate through both visualization techniques concurrently and both concepts are updated once a concept is selected.

- **Use Case:**

- **Name:** NVOS-70
- **Actor** User
- **Preconditions:** Application must be on accessible from a web browser.
- **Description <Flow of events>:**
 - * User should be able to browse to the ontology page.
 - * User should be able to see both the treeview and the graph node visualizations on the same page.
 - * User should be able to browse those visualizations as desired.

[NVOS-71] Enhance Treeview Search Results

- **Description:** As a user, I would like a dynamic search which shows me to search through concepts and see their labels first with their identification numbers below the labels. Also, a scroll bar to view more than 15 terms at a time.

- **Acceptance Criteria:**

- The user should be able to enter words into a search bar and be shown a list of possible corresponding concepts or descriptions.
- The user should be able to select a filter which allows the user to select whether they want to search based on concept, relation, or description similarity.

- **Use Case:**

- **Name:** NVOS-71
- **Actor** User
- **Preconditions:** Application must be on accessible from a web browser.
- **Description <Flow of events>:**
 - * User should be able to enter a word into the search bar.
 - * User should be able to see a list of possible related terms.
 - * User should be able to filter out results by concept, relation, or description.
 - * User should be able to hover over each possible selected term and dynamically the corresponding ontology tree.

[NVOS-72] Node Graph Search

- **Description:** As a user, I would like to be able to search concepts in the ontology so that I can see specific concepts in the node graph visualization and further explore concepts in the ontology.
- **Acceptance Criteria:**
 - Search tool is displayed.
 - User is able to type concept.
 - User is able to click search.
 - Concept is searched and added to visualization.
 - Newly added concept can be expanded by clicking on it.
- **Use Case:**
 - **Name:** NVOS-72
 - **Actor** User
 - **Preconditions:** User is able to access Ontology page by clicking Ontology in the navigation bar.
 - **Description <Flow of events>:**
 - * User clicks "Ontology" from navigation bar.
 - * Page is loaded and displays both tree and graph visualization of the ontology.
 - * User inputs a word and clicks on it.
 - * Graph is updated displaying searched word and related concepts.

[NVOS-87] Autocomplete Search

- **Description:** As a user, I would like an autocomplete feature in the homepage so that I am given suggestions on terms to look for related to environmental research articles.
- **Acceptance Criteria:**
 - The user should be able to see a list of terms related to the environment ontology when the user clicks on the search bar.
 - The user should be able to see the terms autocomplete as they start typing any concept.
- **Use Case:**

- **Name:** NVOS-87
- **Actor** User
- **Preconditions:** Application must be accessible from a web browser.
- **Description <Flow of events>:**
 - * User should be able to see the search bar from the homepage.
 - * User should be able to click and see a list of terms related to the environment ontology when the user clicks on the search bar.
 - * User should be able to see the terms autocomplete as they start typing any concept.

[NVOS-97] Feedback History Page

- **Description:** As a user, I would like to be able to see the articles I have rated so that I can see which ones are helpful for me later on.
- **Acceptance Criteria:**
 - User can log in to user profile.
 - User can click on Feedback History button.
 - User can see list of articles that were rated by user and up arrow for helpful and down arrow for not helpful.
- **Use Case:**
 - **Name:** NVOS-97
 - **Actor** User
 - **Preconditions:** Application must be accessible from a web browser. User must be logged in.
 - **Description <Flow of events>:**
 - * User clicks on Account from the navigation bar and successfully logs in.
 - * User rates some articles upon searching for them.
 - * User accesses the feedback history page from the Account page again.
 - * User sees a list of articles that they rated with the feedback value.

2.2 Pending User Stories

- NVOS-16 Add Markups
 - As a developer, I want to allow the user to add markups to their queries, so that they can put multiple concepts together for a more detailed search.
- NVOS-17 Popular Concepts
 - As a developer, I want to provide the user with popular concepts, so that they are able to see what concepts are used more often for building a query entry.
- NVOS-75 Expand Search Filter
 - As a developer, I want to add a filter for the ontology page search so that I can search through, not only concept labels, but through the descriptions and the relations.
- NVOS-99 Threading in Filter
 - As a developer, I want to thread the filter that was described in NVOS-75.
- NVOS-98 Feedback Indexing
 - As a developer, I want to be able to rank the articles based on a global feedback rank.

3 PROJECT PLAN

This section describes the planning that went into the realization of this project. This project incorporated the agile development techniques and as such required the sprints to be planned. These sprint plannings are detailed in the section. This section also describes the components, both software and hardware, chosen for this project.

3.1 Hardware and Software Resources

- **Angular 6**
 - Angular 6 was used to build the front end functionality with individual components per feature excluding the treeview and node graph visualizations.
- **jQuery/D3**

- jQuery was used to create the treeview and search for the ontology visualizations on the ontology page.
- D3 was used to create the node graph visualization on the ontology page.

- **NodeJS/Express**

- NodeJS/Express was used to build the server that connects to the Mongo Database.

- **MongoDB**

- MongoDB was used to create the EnvoScholar v2.0 database which contains a collection of users (user profile information) and a collection of feedback (user experience feedback).

- **PostgreSQL/Elasticsearch**

- PostgreSQL was used to create the database that contains the articles.
 - Elasticsearch was used in the HTTP GET request to the database to retrieve the articles.
 - *Note: Maria Presa Reyes, an FIU graduate student, is the main contributor for this part of the project.*

- **HTML5/CSS**

- HTML5 and CSS were used to structure the visual aspect of the project and work on the styling.

- **Passport**

- Passport was used as the authentication middleware for NodeJS for users logging into their profile.

- **JWT**

- JWT was used to create the token for login authentication.

- **Atom/Notepad++**

- Atom and Notepad++ were the IDEs used throughout the development of the project.

- **MacOS/Windows 10**

- MacOS Mojave and Windows 10 were the operating systems used during the development of the project.

3.2 Sprints Plan

3.2.1 Sprint 1

Date: January 22, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Deya Banisakher

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- Task NVOS-45 Parse/Restructure Data [\[NVOS-45 Jira Link\]](#)
- Task NVOS-43 Implement Rough Graph Node Visualization [\[NVOS-43 Jira Link\]](#)
- Task NVOS-44 Implement Rough Tree Visualization [\[NVOS-44 Jira Link\]](#)

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany
 - NVOS-45 Parse/Restructure Data
 - NVOS-44 Implement Rough Tree Visualization
- Carlos Bravo
 - NVOS-43 Implement Rough Node Graph Visualization

3.2.2 Sprint 2

Date: February 4, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- User Story NVOS-47 Tree Visualization [[NVOS-47 Jira Link](#)]
- User Story NVOS-48 Node Graph Visualization [[NVOS-48 Jira Link](#)]

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany
 - NVOS-47 Tree Visualization
- Carlos Bravo
 - NVOS-48 Node Graph Visualization

3.2.3 Sprint 3

Date: February 18, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Deya Banisakher

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- User Story NVOS-48 Node Graph Visualization [[NVOS-48 Jira Link](#)]
- User Story NVOS-10 Visualization of Text [[NVOS-10 Jira Link](#)]
- User Story NVOS-64 Dynamic Search in Tree [[NVOS-64 Jira Link](#)]
- Task NVOS-51 Tree Visualization in Microsoft Edge [[NVOS-51 Jira Link](#)]
- Task NVOS-54 Node Graph Visualization in Safari [[NVOS-54 Jira Link](#)]
- Task NVOS-63 Article Search [[NVOS-63 Jira Link](#)]

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany
 - NVOS-10 Visualization of Text

- NVOS-54 Node Graph Visualization in Safari
- NVOS-63 Article Search
- NVOS-64 Dynamic Search in Tree
 - Carlos Bravo
 - NVOS-48 Node Graph Visualization
 - NVOS-10 Visualization of Text
 - NVOS-51 Tree Visualization in Microsoft Edge

3.2.4 Sprint 4

Date: March 4, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Deya Banisakher

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- User Story NVOS-72 Node Graph Search [[NVOS-72 Jira Link](#)]
- User Story NVOS-71 Enhance Treeview Search [[NVOS-71 Jira Link](#)]
- User Story NVOS-10 Visualization of Text [[NVOS-10 Jira Link](#)]

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany
 - NVOS-10 Visualization of Text
 - NVOS-71 Enhance Treeview Search
- Carlos Bravo
 - NVOS-72 Node Graph Search

3.2.5 Sprint 5

Date: March 18, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Deya Banisakher

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- User Story NVOS-70 Unifying Visualization [\[NVOS-70 Jira Link\]](#)
- User Story NVOS-71 Enhance Treeview Search Results [\[NVOS-71 Jira Link\]](#)
- User Story NVOS-34 Feedback [\[NVOS-34 Jira Link\]](#)
- Bug NVOS-78 Fix Search Bar [\[NVOS-78 Jira Link\]](#)
- Bug NVOS-79 Fix Article Selection [\[NVOS-79 Jira Link\]](#)
- Bug NVOS-80 Fix Slow Loading Pages [\[NVOS-80 Jira Link\]](#)
- Bug NVOS-81 Fix Logout Button [\[NVOS-81 Jira Link\]](#)
- Bug NVOS-82 Fix Saved Button [\[NVOS-82 Jira Link\]](#)
- Bug NVOS-83 Fix Share Button [\[NVOS-83 Jira Link\]](#)
- Bug NVOS-84 Fix Footer [\[NVOS-84 Jira Link\]](#)
- Task NVOS-86 Treeview Initial View [\[NVOS-86 Jira Link\]](#)

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany and Carlos Bravo (Team work with multiple subtasks)
 - User Story NVOS-70 Unifying Visualization
- Sheila Alemany
 - NVOS-71 Enhance Treeview Search Results

- NVOS-86 Treeview Initial View
 - Carlos Bravo
- NVOS-34 Feedback

Note: There are many tasks that have not been assigned at the time of the Sprint Planning as either Sheila Alemany or Carlos A Bravo Marin will pick up tasks as they make progress. All bugs from EnvoScholar v1.0 and the goal is simply to fix as many as they can.

3.2.6 Sprint 6

Date: April 1, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Deya Banisakher

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 80.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

- User Story NVOS-70 Unifying Visualization [[NVOS-70 Jira Link](#)]
- User Story NVOS-71 Enhance Treeview Search Results [[NVOS-71 Jira Link](#)]
- User Story NVOS-34 Feedback [[NVOS-34 Jira Link](#)]
- User Story NVOS-87 Autocomplete Search [[NVOS-87 Jira Link](#)]
- User Story NVOS-97 Feedback History on User Profile [[NVOS-97 Jira Link](#)]
- Task NVOS-86 Treeview Initial View [[NVOS-86 Jira Link](#)]
- Task NVOS-93 Slow Loading Pages [[NVOS-93 Jira Link](#)]
- Task NVOS-94 Keep Search Concept [[NVOS-94 Jira Link](#)]
- Task NVOS-95 Saved Button Update [[NVOS-95 Jira Link](#)]
- Task NVOS-96 Highlight Function [[NVOS-96 Jira Link](#)]

The team members indicated their willingness to work on the following user stories.

- Sheila Alemany
 - NVOS-71 Enhance Treeview Search Results
 - NVOS-70 Unifying Visualization
 - NVOS-86 Treeview Initial View
 - NVOS-87 Autocomplete Search
 - NVOS-94 Keep Search Concept
 - NVOS-95 Saved Button Update
 - NVOS-96 Highlight Function
- Carlos Bravo
 - NVOS-70 Unifying Visualization
 - NVOS-34 Feedback
 - NVOS-97 Feedback History on User Profile
 - NVOS-93 Slow Loading Pages

3.2.7 Sprint 7

Date: April 1, 2019

Attendees: Sheila Alemany, Carlos Bravo

Start time: 2:00 PM

End time: 3:00 PM

After discussion, the velocity of the team were estimated to be 40.

The product owner chose the following tasks to be done during the next sprint. They are ordered based on their priority.

- Finish all required documentation.
- Create powerpoint presentation.
- Submit posters.
- Submit final version of the code to dev branch.
- Record videos to be passed on to future students:

- Introduction Video
- User Guide Video
- Installation Video
- Shortcomings/Wishlist Video

4 SYSTEM DESIGN

This section contains information on the design decisions that went into EnvoScholar v2.0. The architecture patterns are outlined and explained. The entire system is shown in a package diagram and the subsystems are explained. Finally, the design patterns used in the project are discussed.

4.1 Architectural Patterns

A Client-Server and Model View Controller (MVC) architectural pattern was used in this project for the presentation layer as it allows the separation of internal information from the ways that the information is actually displayed to viewer. The MVC architectural pattern includes three interconnected parts, that is, model, controller, and view. The model determines the application data structure and manages data and logic, while the view presents the actual information such as article search results to the users. The controller receives the request and then passes them to the model. Such an architectural pattern allows the coding of each part separately.

4.2 System and Subsystem Decomposition

There are three main systems in EnvoScholar, the web client subsystem, the business logic subsystem, and the data subsystem. In this section, we will describe what each of those subsections did individually to contribute to the creation of this academic search engine.

Web Client Subsystem

The web client subsystem, or the "views" in the figure above, contains the presentation that the average EnvoScholar user will interact with directly. This subsystem was also implemented using the MVC architectural pattern. Most of the work implemented by us in this iteration of EnvoScholar involves developing and improving upon features in this web client subsystem. Below is the list of the interfaces that have been created in this project:

- Autocomplete interface on the homepage
- Tree structure interface on the ontology page

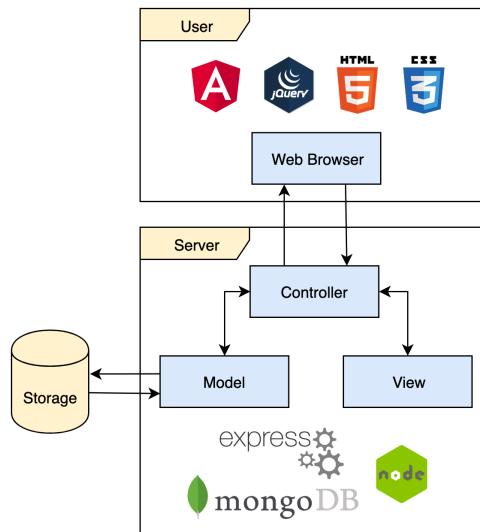


Figure 1: Client-Server and Model View Controller (MVC) Architectural Pattern

- Node graph structure interface on the ontology page
- Feedback interface on the display search results page and the feedback history interface on the profile
- Dynamic search interface for the ontology page
- User profile interface
- Individual article information page interface with text visualization

To receive the request from these views and pass them to the models, a number of controllers were created, including the controller that accesses the ontology files for the proper concepts and relationships. These controllers interact with models to provide the output information.

Business Logic Subsystem

The business logic subsystem, or the controller, is the core of the system that interacts with both the web client subsystem and data subsystem. This subsystem was implemented to handle the following functions in this project:

- Extract the set of concepts from the ENVO ontology
- Run algorithm to create treeview and node graph structures

- Support the dynamic search function in both the ontology page and the autocomplete on the homepage
- Manage user profiles and feedback history
- Save articles
- Process related concepts
- Run the highlighting function in the visualization of text

Data Subsystem

The data system is the subsystem which is responsible for the access, storage, and management of data. The data management system used in this project is MongoDB to store the user account information along with the global feedback information. The MongoDB part of this project that was manipulated in this iteration of the project by us was the storage of the feedback for an individual feedback and a global feedback value. The Elasticsearch is used for all the data management used with the articles in the search engine. As mentioned in Section 3, this Elasticsearch was minimally not accessed by us and only accessed by the graduate students of the project.

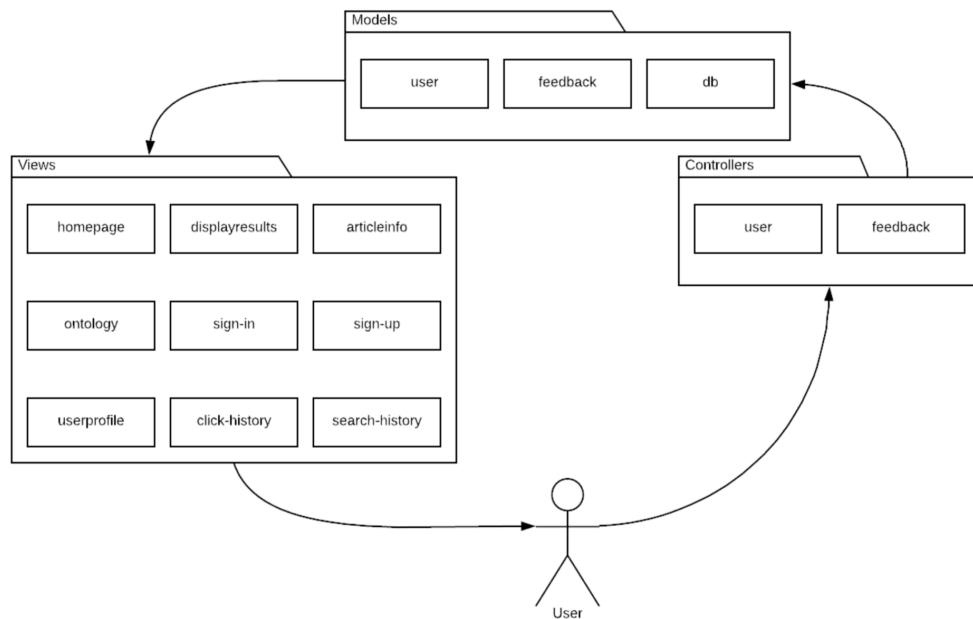


Figure 2: System and Subsystem Decomposition of EnvoScholar using MVC

4.3 Deployment Diagram

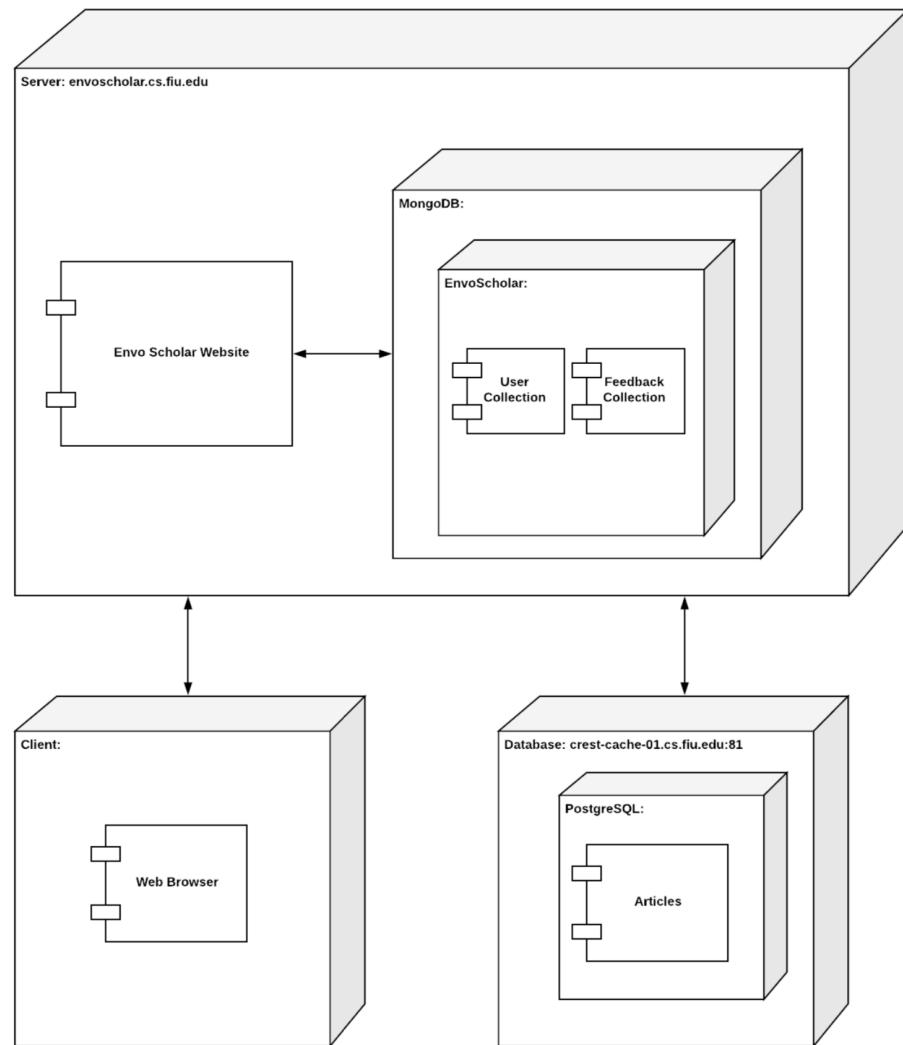


Figure 3: Deployment Diagram of EnvoScholar

5 SYSTEM VALIDATION

5.1 Unit Tests

[NVOS-10] Visualization of Text

- **Test Case ID:** NVOS-10-T01
- **Description/Summary of Test:**
 - User has selected a concept relevant to the article selected.
 - User has seen all the sentences in the abstract that contain those concepts clearly highlighted.
 - User has removed all highlight once they no longer wish to view the highlighted sentences.
- **Pre-condition:** User is on the Article Information page.
- **Expected Results:** User should be able to clearly see all the sentences in the abstract where the concept is located.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-34] Article Feedback

- **Test Case ID:** NVOS-34-T01
- **Description/Summary of Test:**
 - User clicks arrow UP or arrow DOWN.
 - Rating is sent to MongoDB.
 - Arrow changes color to indicating success. Green for UP and red for DOWN.
- **Pre-condition:** User is on the Display Results page.
- **Expected Results:** Arrow changes color accordingly.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-34] Article Feedback

- **Test Case ID:** NVOS-34-T02
- **Description/Summary of Test:**
 - User clicks arrow DOWN.
 - Rating is sent to MongoDB.
 - Arrow changes color to red.
- **Pre-condition:** User is on the Display Results page.
- **Expected Results:** Arrow changes color to red.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-34] Article Feedback

- **Test Case ID:** NVOS-34-T03
- **Description/Summary of Test:**
 - User clicks arrow UP.
 - Rating is sent to MongoDB.
 - Arrow changes color to green.
- **Pre-condition:** User is on the Display Results page.
- **Expected Results:** Arrow changes color to green.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-47] Tree Visualization

- **Test Case ID:** NVOS-47-T01
- **Description/Summary of Test:**
 - User has browsed to the treeview page.

- User selected a concept.
 - Treeview page displays a dynamic tree structure properly showing the ontology hierarchy.
- **Pre-condition:** User is on another page and selects Treeview from the navigation bar.
 - **Expected Results:** User should see the dynamic ontology hierarchy for the specific selected concept.
 - **Actual Result:** Users sees the dynamic ontology hierarchy for any specific selected concept.
 - **Status (Fail/Pass):** Pass.

[NVOS-48] Graph Node Visualization

- **Test Case ID:** NVOS-48-T01
 - **Description/Summary of Test:**
 - User has browsed to the node graph view page.
 - User clicked on a concept.
 - Node graph dynamically updated related concepts when clicking a node.
- **Pre-condition:** User is on another page and selects node graph from the navigation bar and then clicks a node.
 - **Expected Results:** User should see the starting dynamic ontology graph and updated graph after clicking.
 - **Actual Result:** User sees ontology graph and its updated when a node is clicked.
 - **Status (Fail/Pass):** Pass.

[NVOS-64] Dynamic Search in Tree

- **Test Case ID:** NVOS-64-T01
- **Description/Summary of Test:**
 - User has entered string in the search bar.
 - User has hovered over one of the list of resulting concepts.

- User can see the treeview hierarchy of the corresponding result.
- **Pre-condition:** User is on the Treeview page.
- **Expected Results:** User should be able to easily search for terms, hover over terms, and dynamically see the treeview.
- **Actual Result:** User dynamically sees the treeview of search concepts.
- **Status (Fail/Pass):** Pass.

[NVOS-70] Unifying Visualization

- **Test Case ID:** NVOS-70-T01
- **Description/Summary of Test:**
 - User has browsed to the Ontology page.
 - User selected a concept or searched for a concept.
 - User sees a dynamic tree structure and node graph properly showing the ontology hierarchy.
- **Pre-condition:** User is on another page and selects Ontology from the navigation bar.
- **Expected Results:** User should see the dynamic ontology hierarchy and node graph for the specific selected or searched concept.
- **Actual Result:** Users sees the dynamic ontology hierarchy for any specific selected concept with the various visualization techniques.
- **Status (Fail/Pass):** Pass.

[NVOS-71] Enhance Treeview Search Results

- **Test Case ID:** NVOS-71-T01
- **Description/Summary of Test:**
 - User has entered a string into the search bar.
 - User has seen a list of concepts in the ENVO ontology that contain the entered string.
 - User can see the identification numbers under the bolded concepts.

- User can hovered over or clicked a concept and saw the concept reflected in the treeview and node graph.
- **Pre-condition:** User is on the Ontology page.
- **Expected Results:** User should be able to easily and intuitively search for concepts in the ontology.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-72] Node Graph Search

- **Test Case ID:** NVOS-72-T01
- **Description/Summary of Test:**
 - User enters concept on search bar.
 - User hover over a concept.
 - User can see a new graph in the Node Graph block.
- **Pre-condition:** User accessed Ontology page and enters a concepts that exists in the ENVO ontology.
- **Expected Results:** User should be able to see node graph containing searched concepts is displayed.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-87] Autocomplete Search

- **Test Case ID:** NVOS-87-T01
- **Description/Summary of Test:**
 - User double clicks on the search bar and sees a list of concepts from the ENVO ontology.
 - User has entered a string into the search bar.
 - User has seen a list of concepts in the ENVO ontology that contain the entered string.

- **Pre-condition:** User is on the Homepage.
- **Expected Results:** User should be able to easily and intuitively search for concepts in the ontology.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

[NVOS-97] Feedback History Page

- **Test Case ID:** NVOS-97-T01
- **Description/Summary of Test:** User is able to see their Article Feedback History from user's profile.
- **Pre-condition:**
 - MongoDB is properly connected.
 - User is logged into their account.
 - User has made at least one search.
 - User has rated at least one article.
 - User is on the Feedback History page.
- **Expected Results:** User should be able to see the Article Feedback History.
- **Actual Result:** The expected results are equal to the actual result.
- **Status (Fail/Pass):** Pass.

5.2 Integrated Tests

[NVOS-10] Visualization of Text

- **Test Case ID:** NVOS-10-T02
- **Description/Summary of Test:** All the possible sentences are highlighted entirely upon selection of a concept.
- **Pre-condition:** All the relevant concepts are properly displayed on the Article Information page.

- **Expected Results:** The sentences in the abstract are highlighted upon selection of a concept.
- **Actual Result:** The Article Information page follows the expected behavior.
- **Status (Fail/Pass):** Pass.

[NVOS-34] Article Feedback

- **Test Case ID:** NVOS-34-T04
- **Description/Summary of Test:** Feedback is sent to MongoDB and article rating is updated.
- **Pre-condition:** Search results are displayed and arrows for feedback are displayed.
- **Expected Results:** MongoDB is updating with new rating.
- **Actual Result:** The database follows the expected behavior.
- **Status (Fail/Pass):** Pass.

[NVOS-47] Treeview Visualization

- **Test Case ID:** NVOS-47-T02
- **Description/Summary of Test:** Validate that the treeview can process and display the correct concepts.
- **Pre-condition:** Ontology is properly retrieved and parsed by the backend.
- **Expected Results:** The dynamic ontology hierarchy is displayed for any selected concept.
- **Actual Result:** The treeview page follows the expected result and the proper dynamic ontology hierarchy is shown.
- **Status (Fail/Pass):** Pass.

[NVOS-48] Graph Node Visualization

- **Test Case ID:** NVOS-48-T02
- **Description/Summary of Test:** Validate that the node graph view can process and display the correct concepts.
- **Pre-condition:** Ontology is properly retrieved and parsed by the backend.

- **Expected Results:** The dynamic ontology hierarchy is displayed for any selected concept.
- **Actual Result:** The node graph page follows the expected result and the proper dynamic ontology graph is shown.
- **Status (Fail/Pass):** Pass.

[NVOS-64] Dynamic Search in Tree

- **Test Case ID:** NVOS-64-T02
- **Description/Summary of Test:** Validate that the treeview can process and search for the correct concepts.
- **Pre-condition:** Ontology concepts are properly retrieved and parsed by the backend.
- **Expected Results:** The dynamic ontology hierarchy is displayed for any concept once the user hovers on the term.
- **Actual Result:** The treeview page follows the expected result and the proper dynamic ontology hierarchy is shown.
- **Status (Fail/Pass):** Pass.

[NVOS-70] Unifying Visualization

- **Test Case ID:** NVOS-70-T02
- **Description/Summary of Test:** Validate that the treeview and node graph can process and display the correct concepts simultaneously.
- **Pre-condition:** Ontology is properly retrieved and parsed by the backend.
- **Expected Results:** The dynamic ontology hierarchy is displayed for any selected or searched concept in the treeview and node graph.
- **Actual Result:** The Ontology page follows the expected result and the proper dynamic ontology hierarchy is shown.
- **Status (Fail/Pass):** Pass.

[NVOS-71] Enhance Treeview Search Results

- **Test Case ID:** NVOS-71-T02

- **Description/Summary of Test:** All the possible related concepts are shown in the search results and can be accessed using a scrollbar.
- **Pre-condition:** The user is on the Ontology page.
- **Expected Results:** The corresponding concepts are shown when the user enters a string.
- **Actual Result:** The search bar follows the expected behavior.
- **Status (Fail/Pass):** Pass.

[NVOS-72] Node Graph Search

- **Test Case ID:** NVOS-72-T02
- **Description/Summary of Test:** Entered concepts are searched upon hover from autocomplete list and new graph is displayed containing the searched concept along its related concepts.
- **Pre-condition:** Initial graph is properly displaying.
- **Expected Results:** New graph is displayed containing searched concept.
- **Actual Result:** The search follows the expected behavior.
- **Status (Fail/Pass):** Pass.

[NVOS-87] Autocomplete Search

- **Test Case ID:** NVOS-87-T02
- **Description/Summary of Test:** All the possible related concepts are shown from the homepage and can be accessed using a scrollbar.
- **Pre-condition:** The user is on the Homepage.
- **Expected Results:** The corresponding concepts are shown when the user enters a string.
- **Actual Result:** The autocomplete search bar follows the expected behavior.
- **Status (Fail/Pass):** Pass.

[NVOS-97] Feedback History Page

- **Test Case ID:** NVOS-97-T02
- **Description/Summary of Test:** Validate that the article feedback is stored, updated, retrieved from MongoDB, and displayed on user's profile.
- **Pre-condition:** The user is registered and logged in.
- **Expected Results:** List of articles along with arrow up or down depending on user feedback.
- **Actual Result:** List of articles are displayed accordingly from information stored in MongoDB.
- **Status (Fail/Pass):** Pass.

6 APPENDIX

6.1 Appendix A - UML Diagrams

6.1.1 Use Case Diagrams

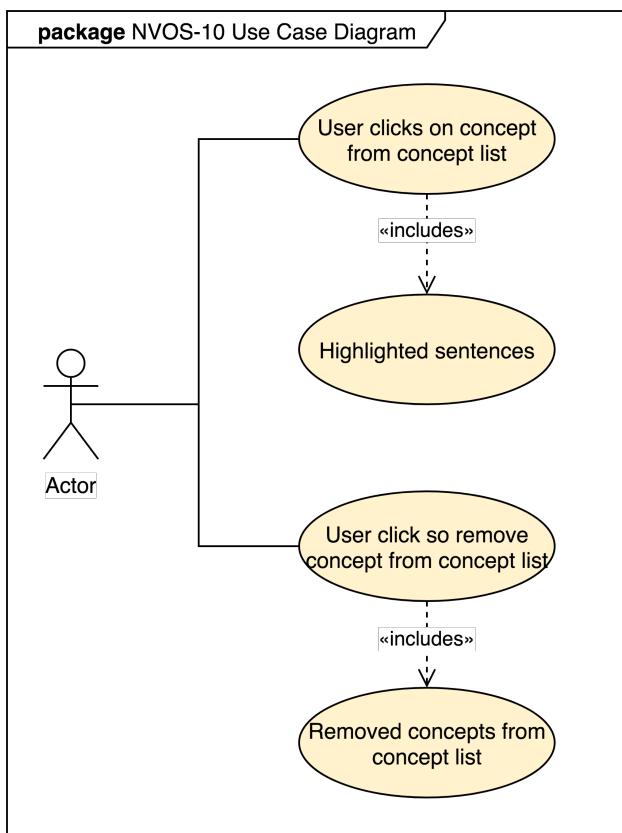


Figure 4: [NVOS-10] Visualization of Text Use Case Diagram

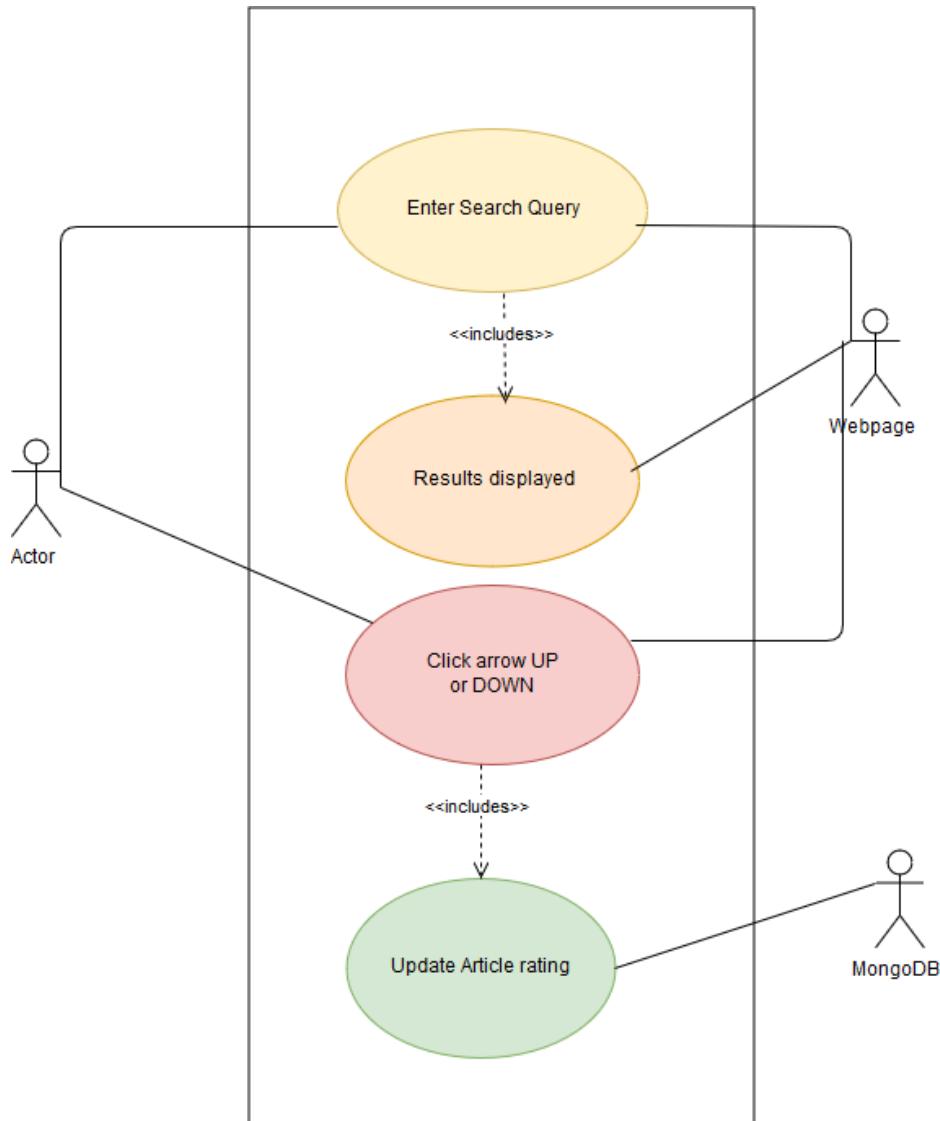


Figure 5: [NVOS-34] Article Feedback Use Case Diagram

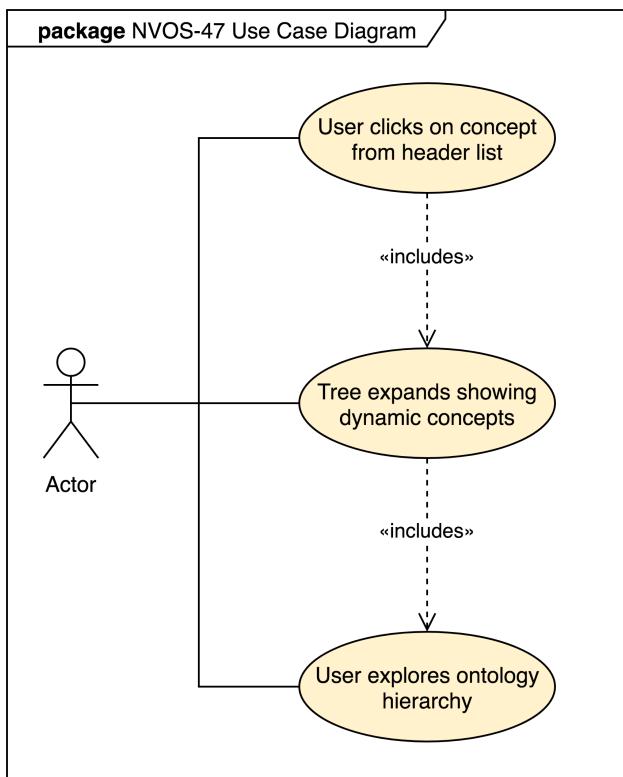


Figure 6: [NVOS-47] Tree Visualization Use Case Diagram

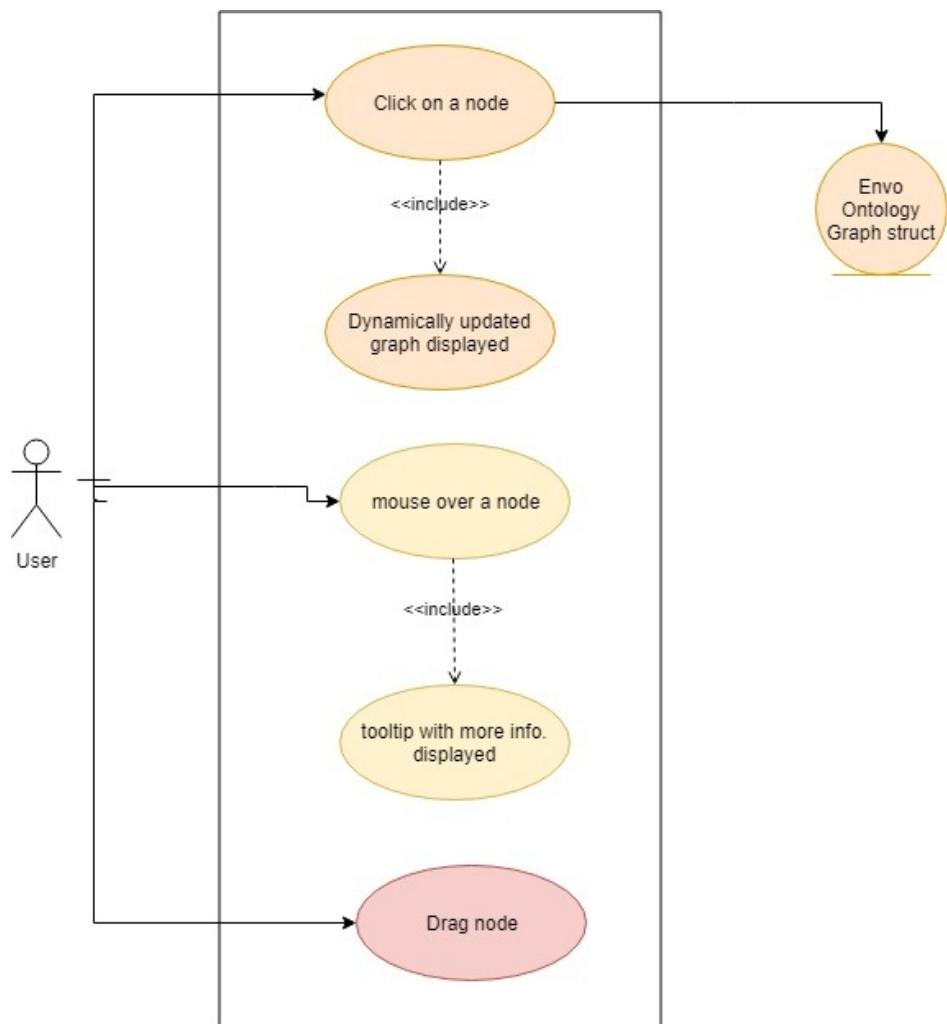


Figure 7: [NVOS-48] Node Graph Visualization Use Case Diagram

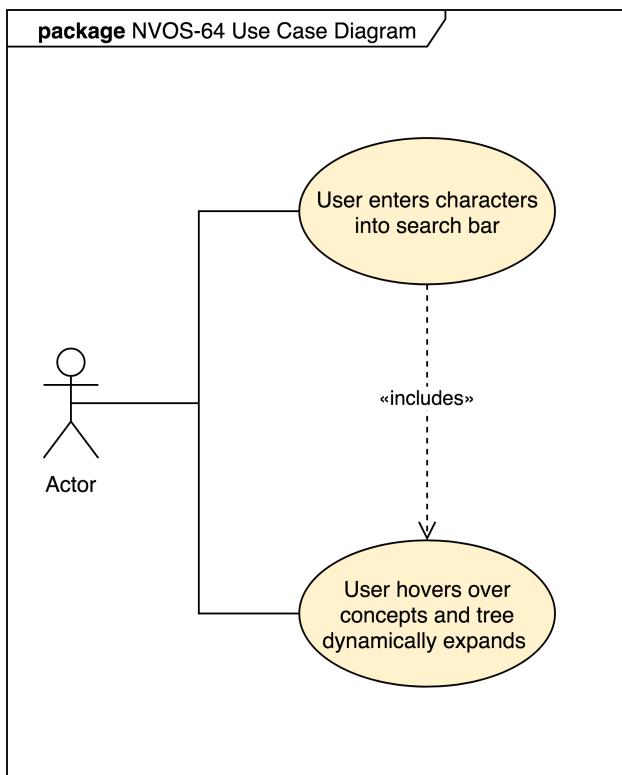


Figure 8: [NVOS-64] Dynamic Search in Tree Use Case Diagram

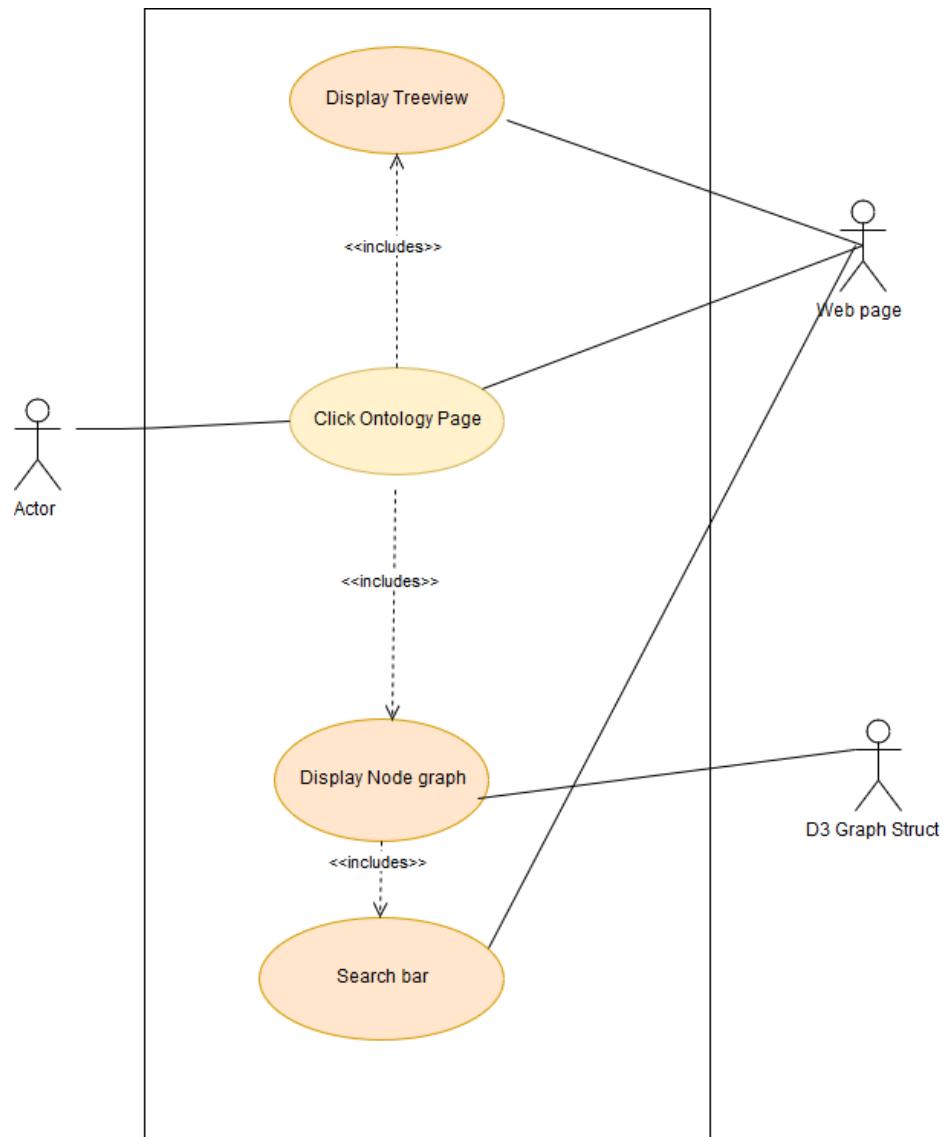


Figure 9: [NVOS-70] Unifying Visualization Use Case Diagram

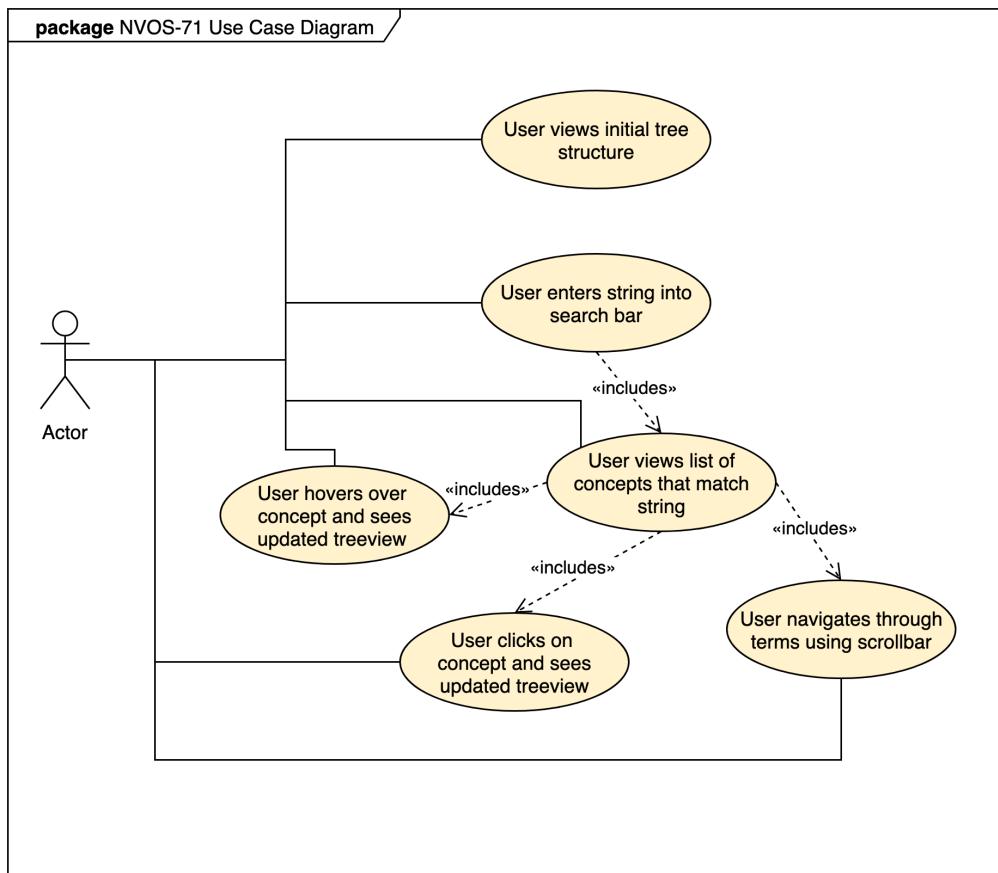


Figure 10: [NVOS-71] Enhance Treeview Search Results Use Case Diagram

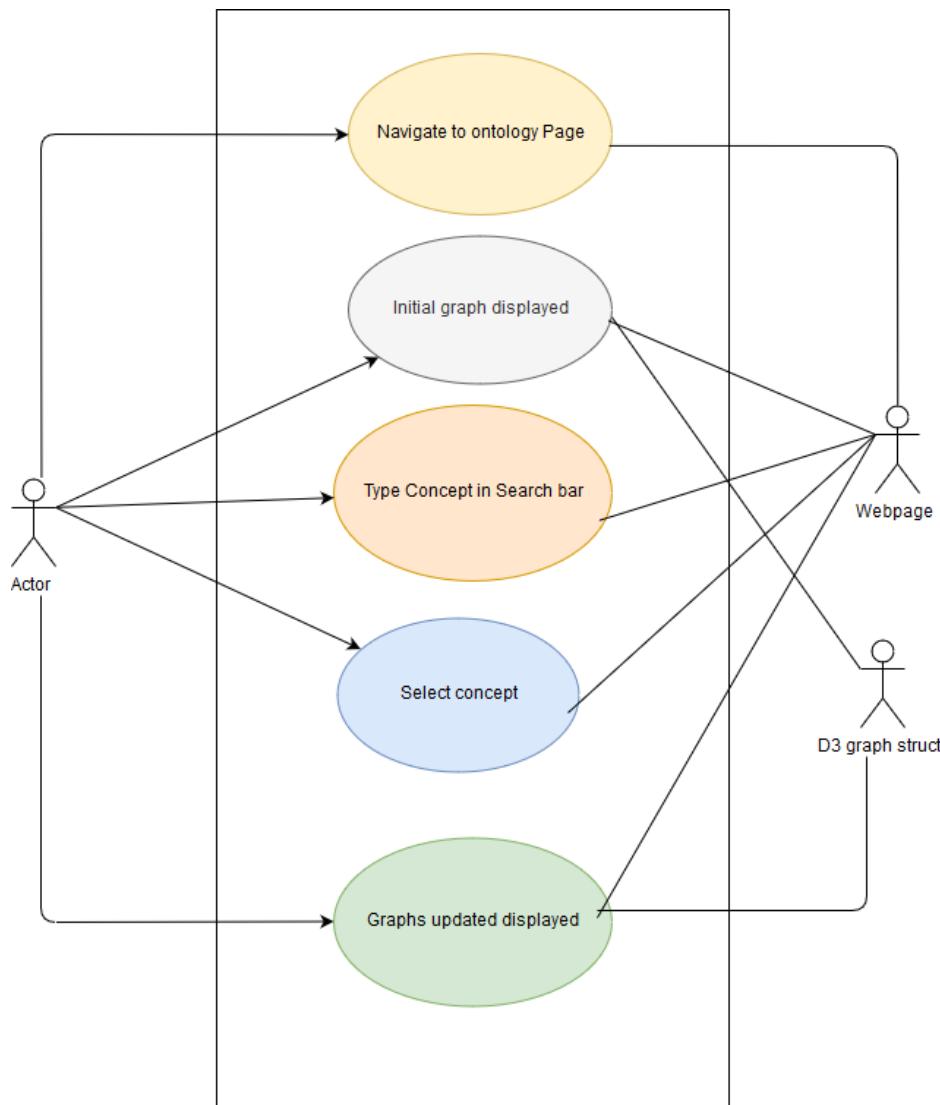


Figure 11: [NVOS-72] Node Graph Search Use Case Diagram

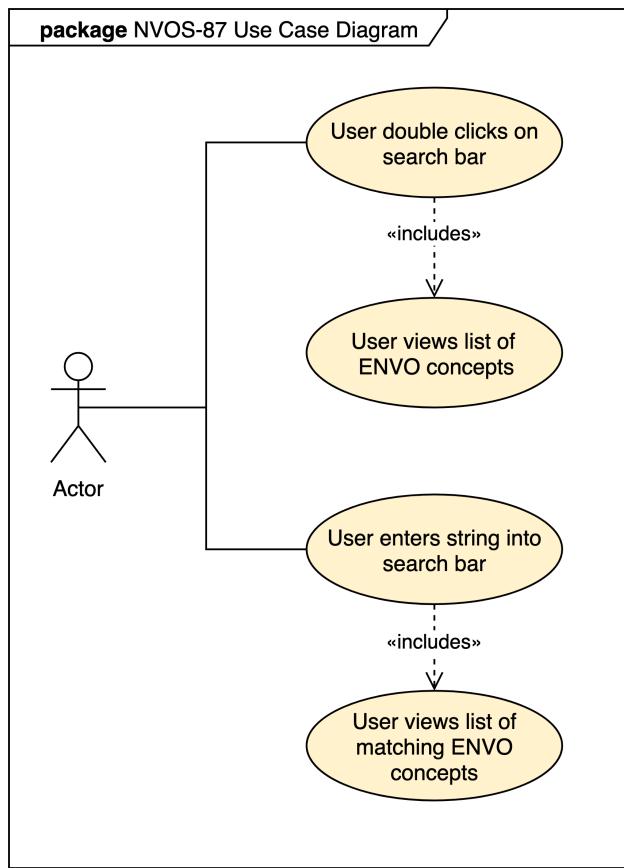


Figure 12: [NVOS-87] Autocomplete Search Use Case Diagram

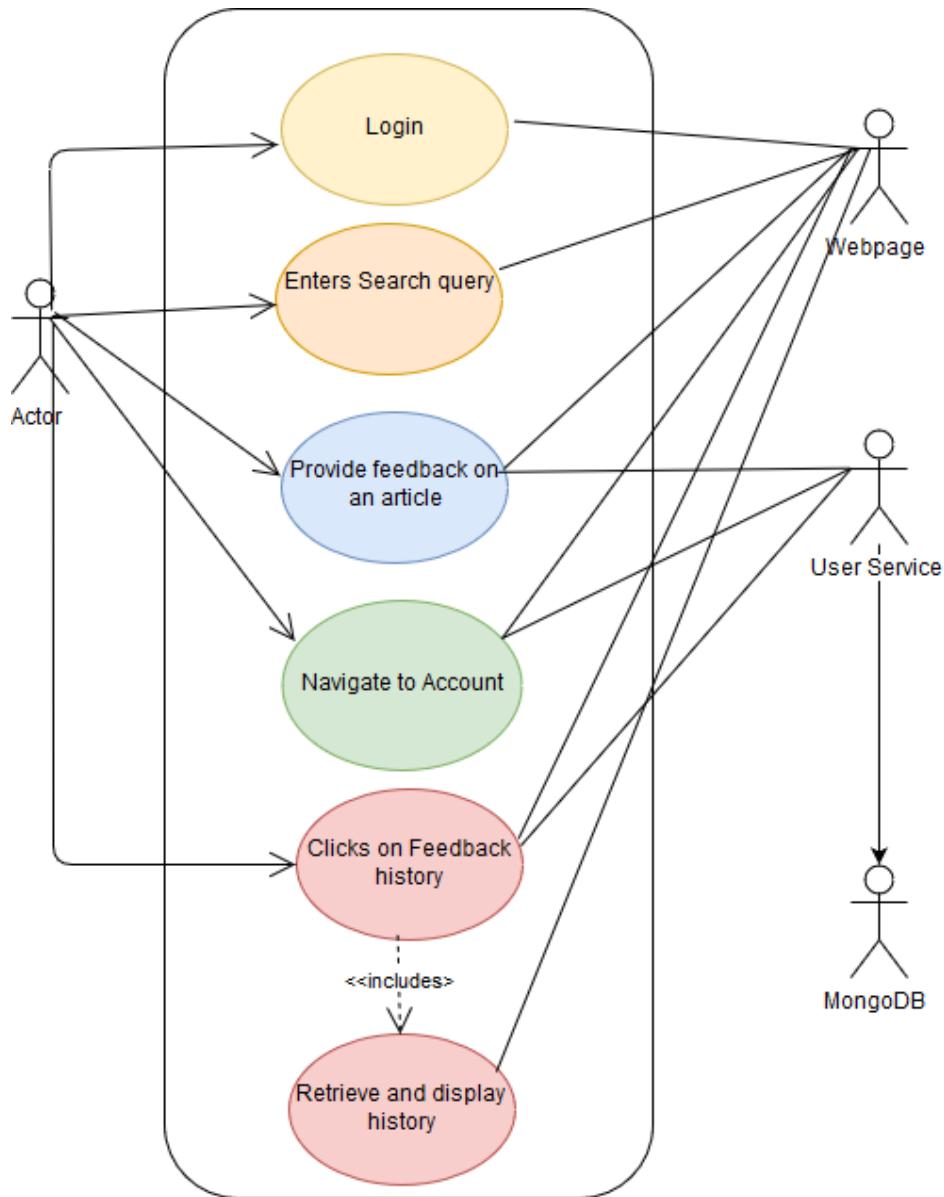


Figure 13: [NVOS-97] Feedback History Page Use Case Diagram

6.1.2 Sequence Diagrams

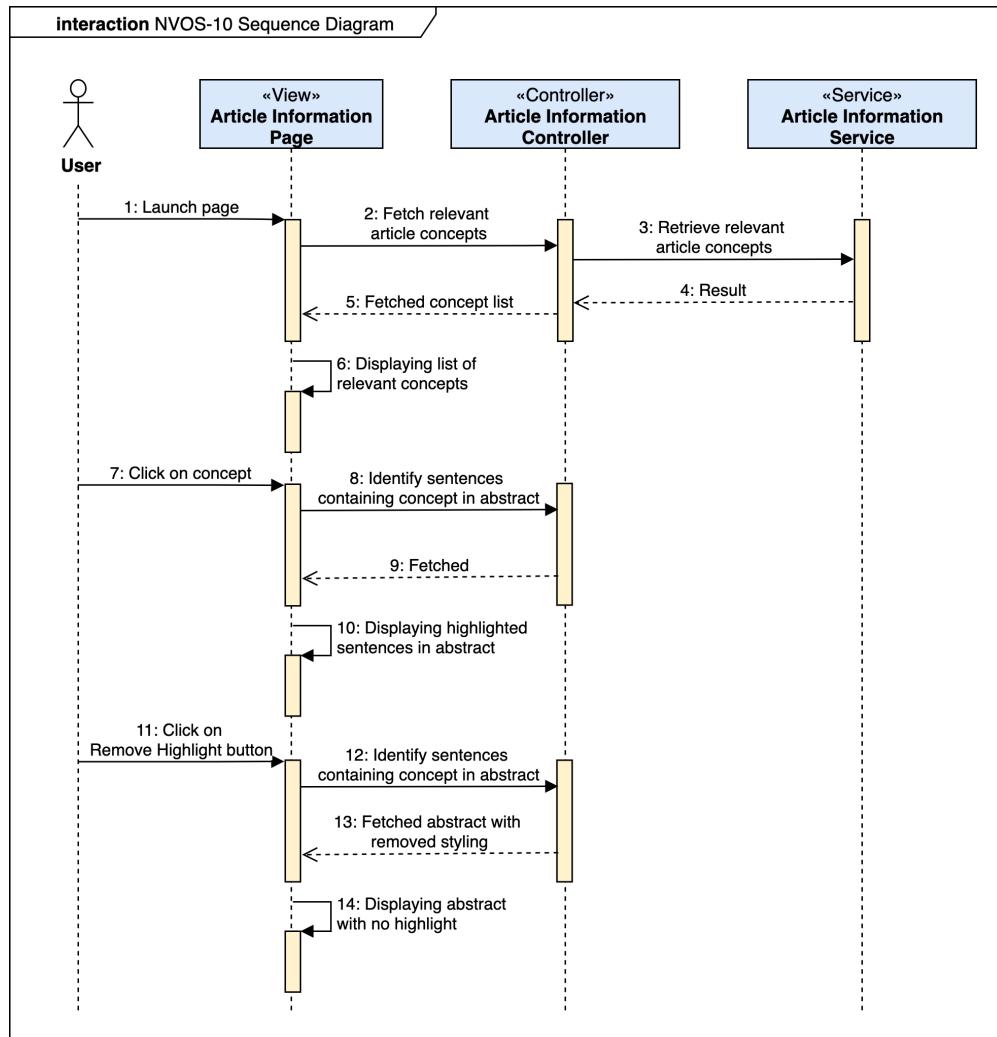


Figure 14: [NVOS-10] Visualization of Text Sequence Diagram

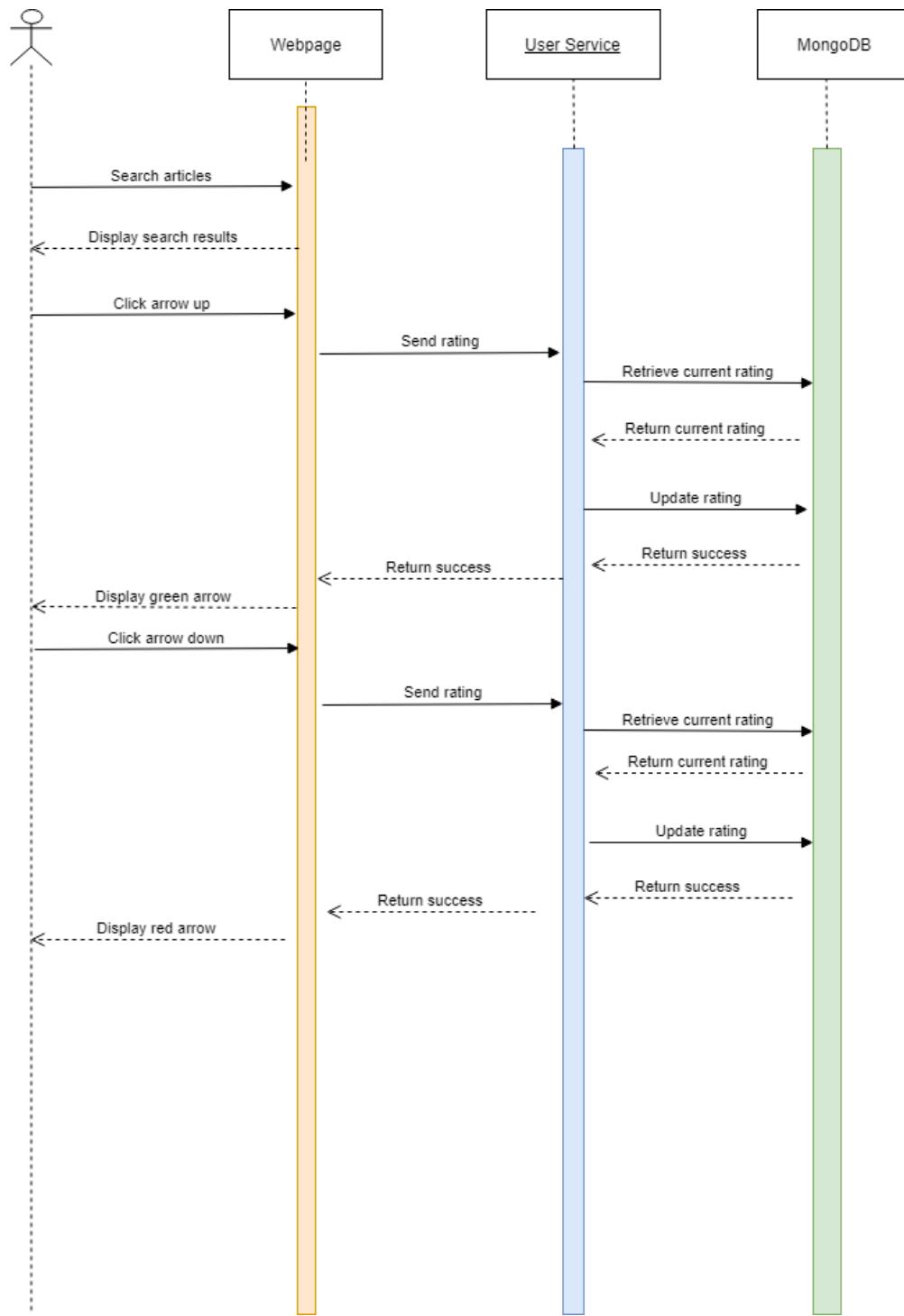


Figure 15: [NVOS-34] Article Feedback Sequence Diagram

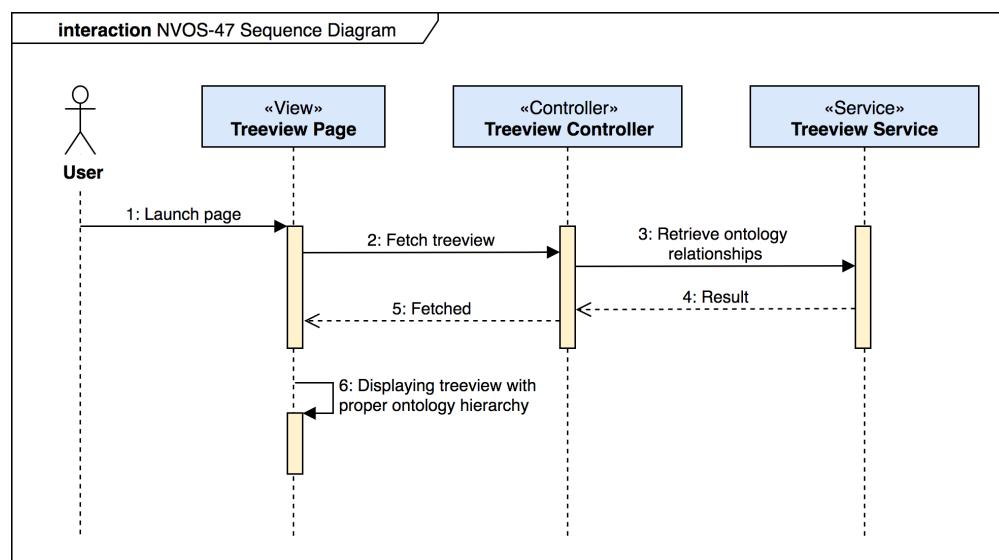


Figure 16: [NVOS-47] Tree Visualization Sequence Diagram

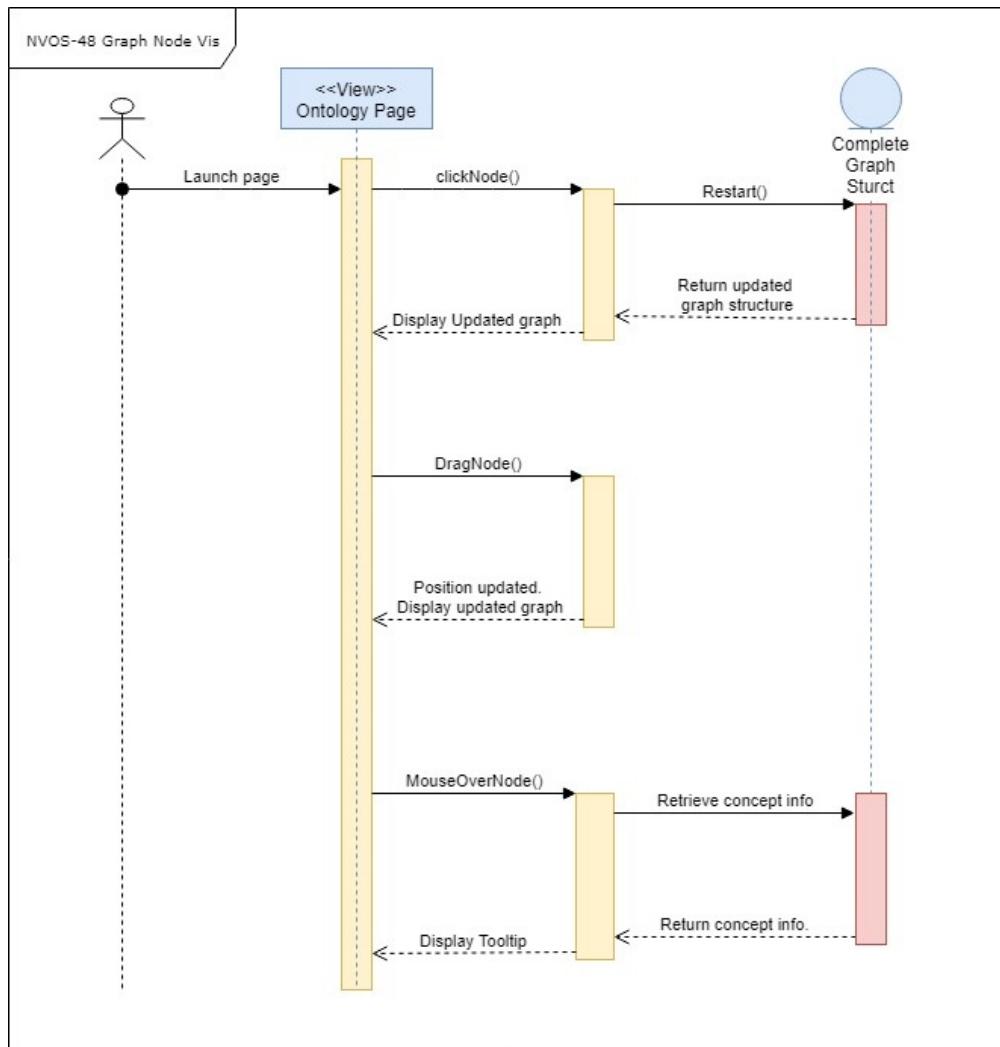


Figure 17: [NVOS-48] Graph Node Visualization Sequence Diagram

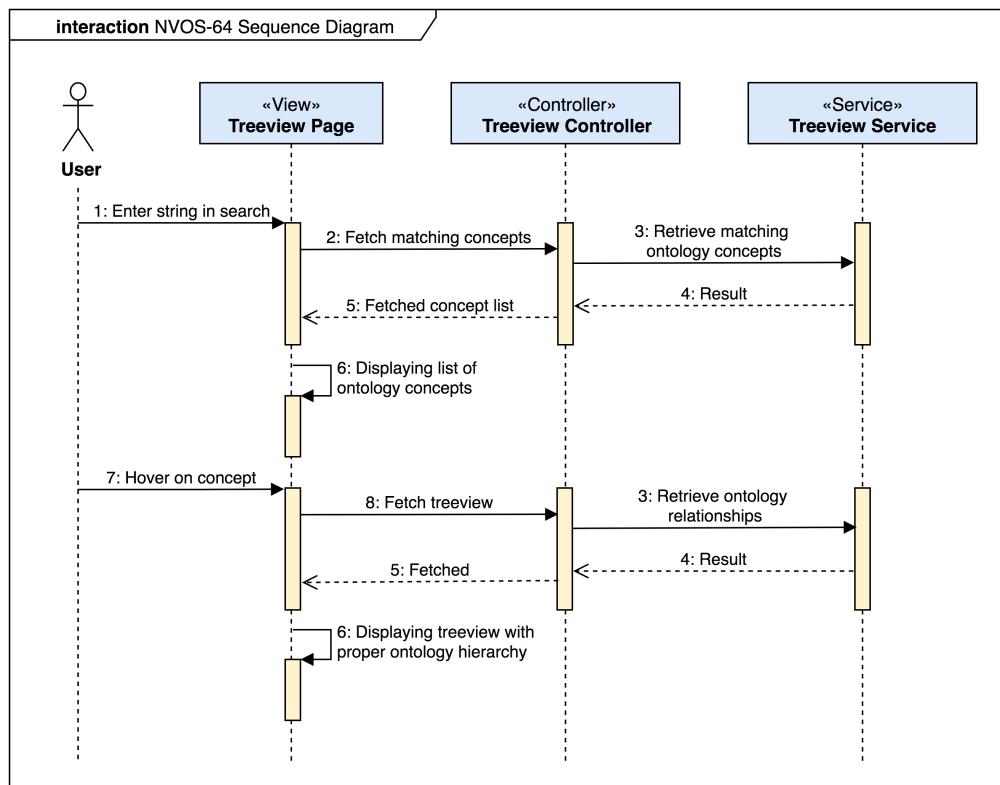
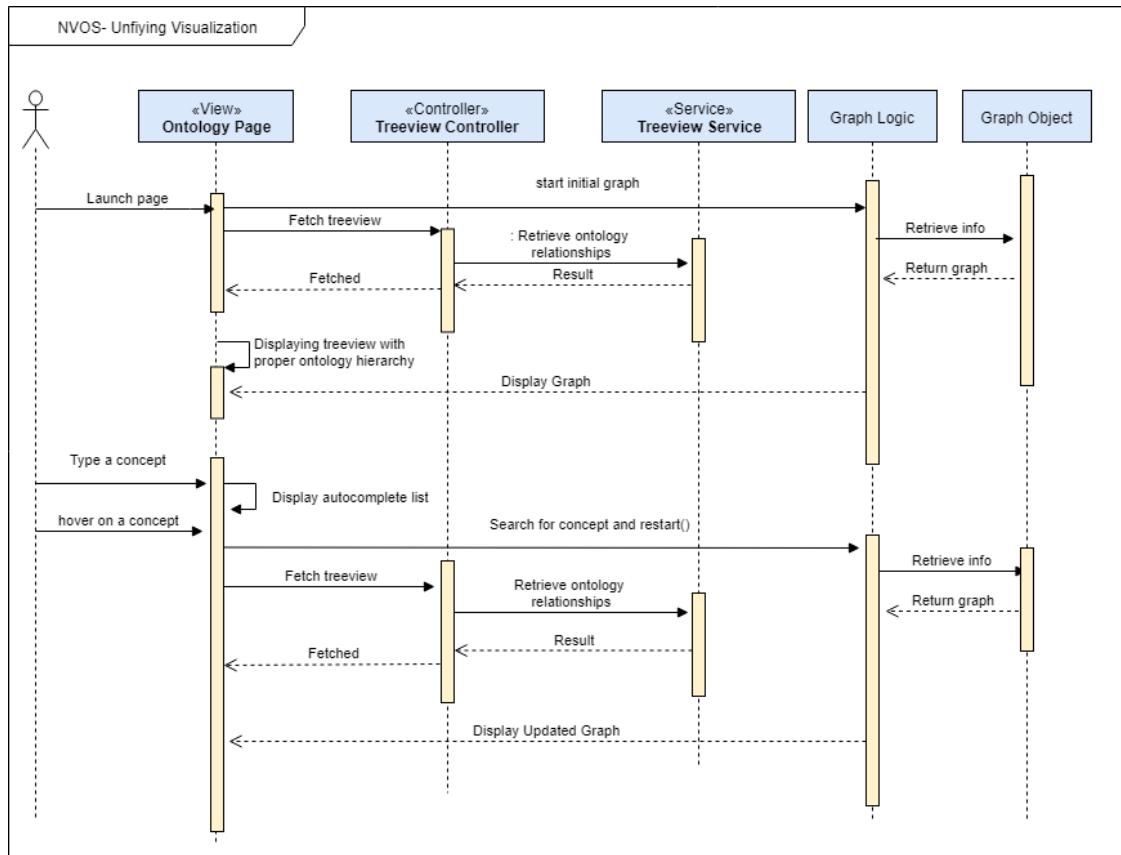
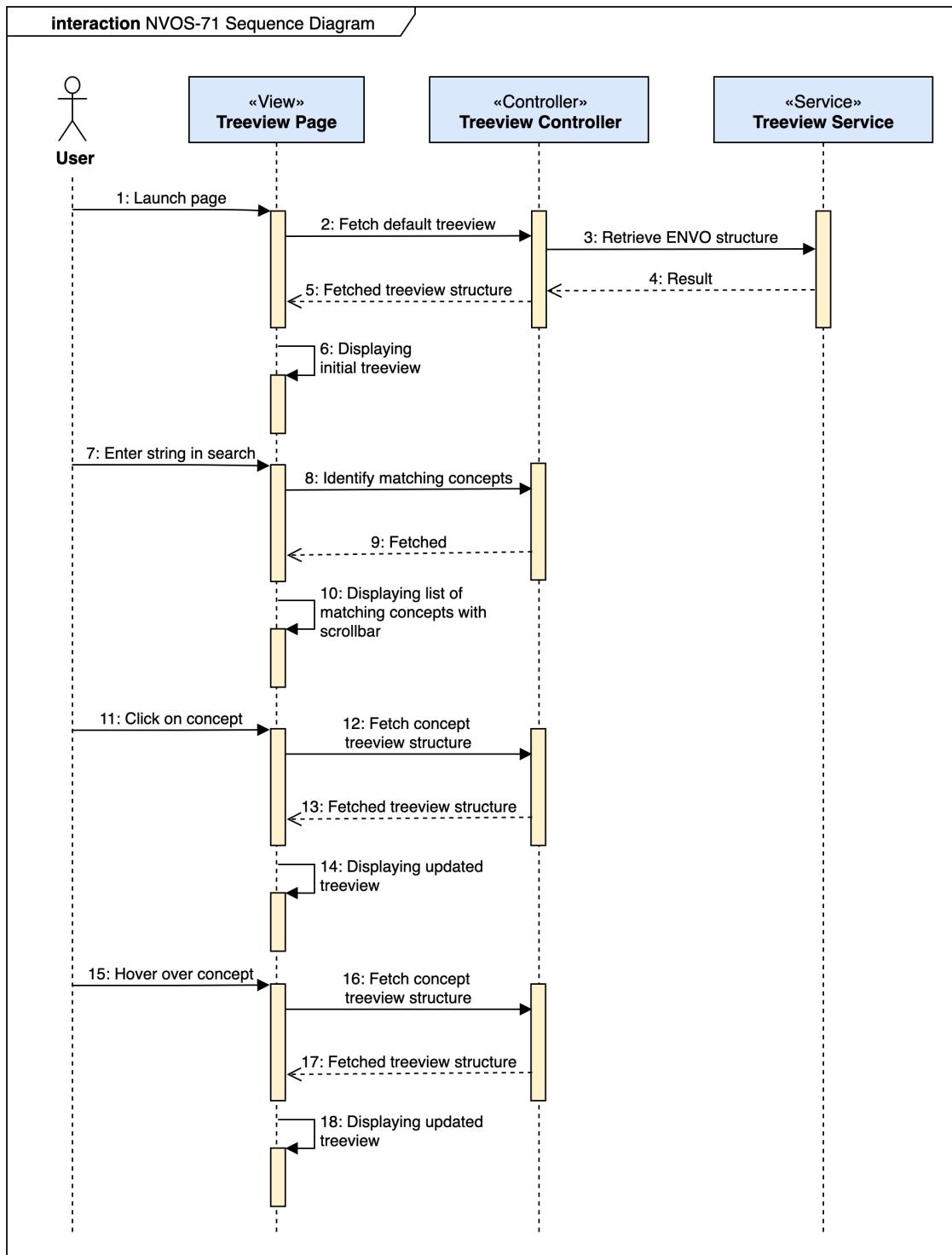


Figure 18: [NVOS-64] Dynamic Search in Tree Sequence Diagram

**Figure 19:** [NVOS-70] Unifying Visualization Results Sequence Diagram

**Figure 20:** [NVOS-71] Enhance Treeview Search Results Sequence Diagram

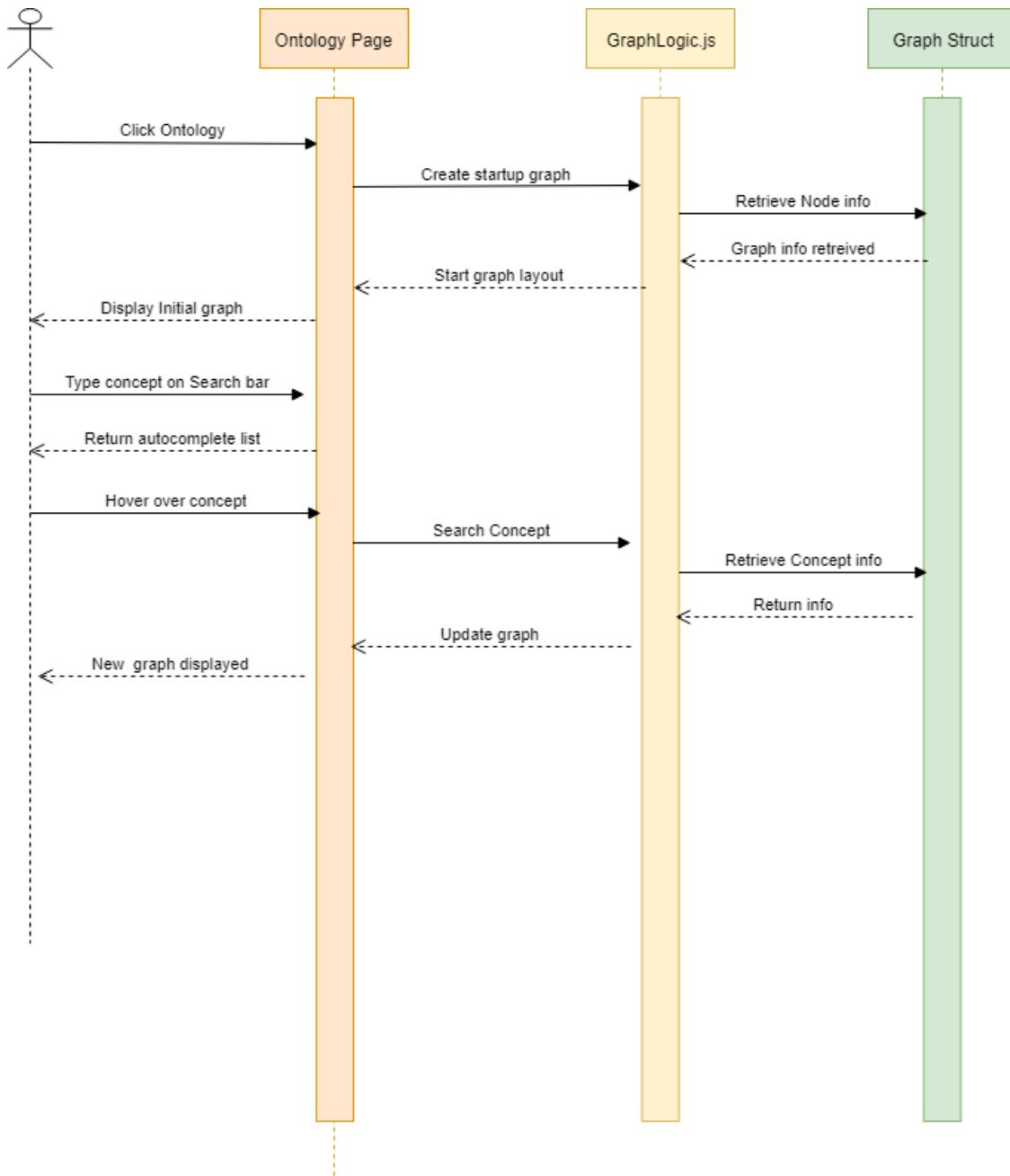


Figure 21: [NVOS-72] Node Graph Search Sequence Diagram

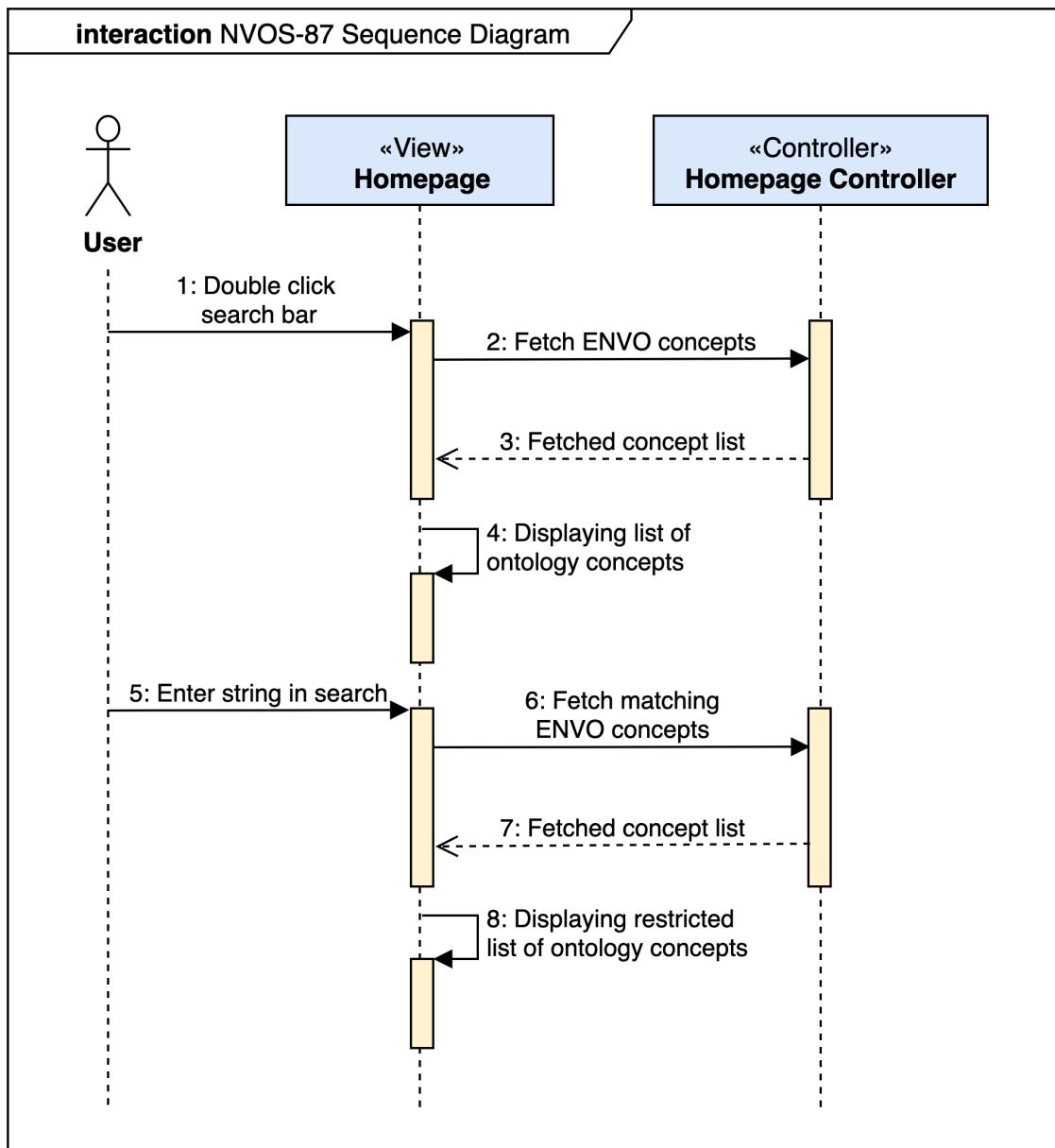


Figure 22: [NVOS-87] Autocomplete Search Sequence Diagram

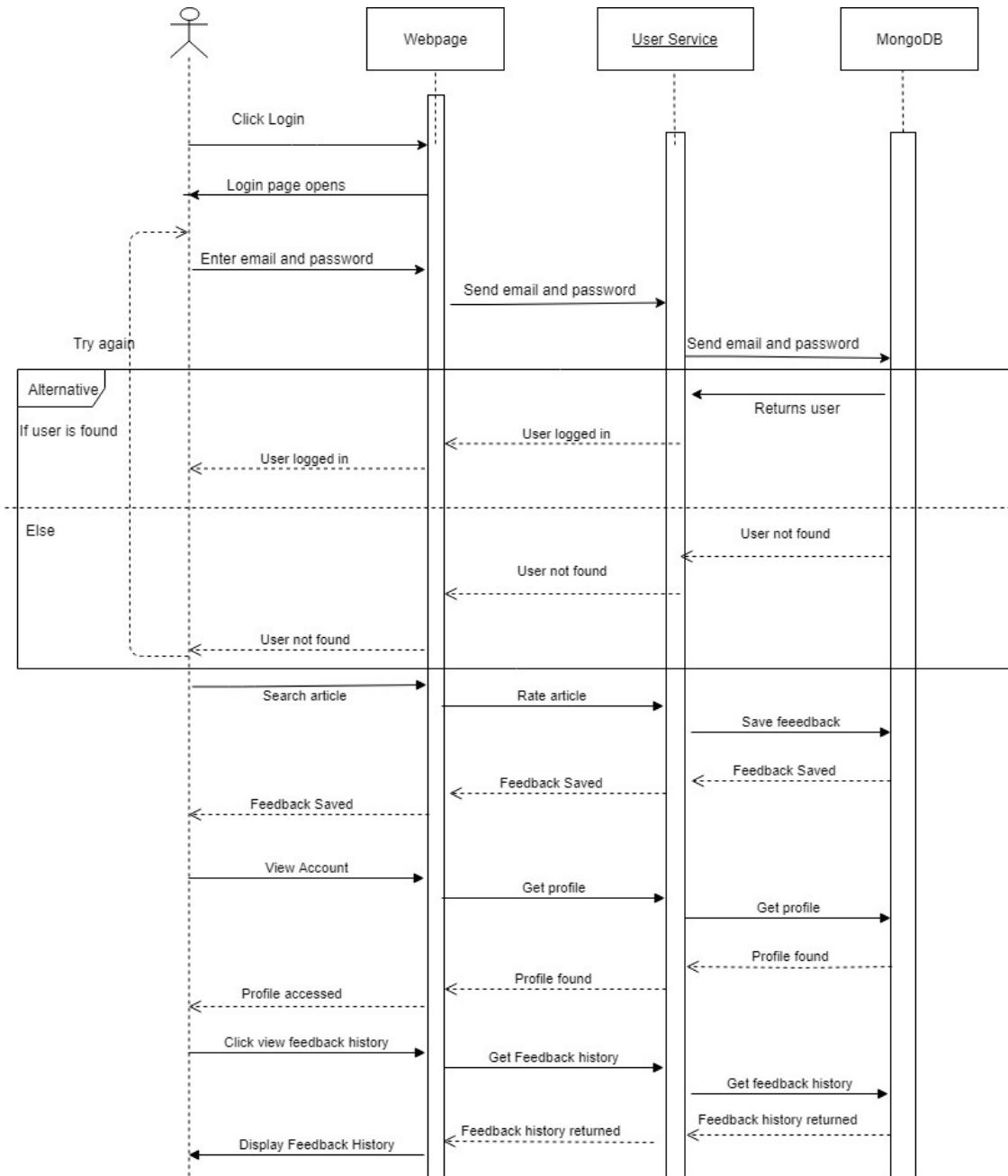


Figure 23: [NVOS-97] Feedback History Page Sequence Diagram

6.1.3 Class Diagrams

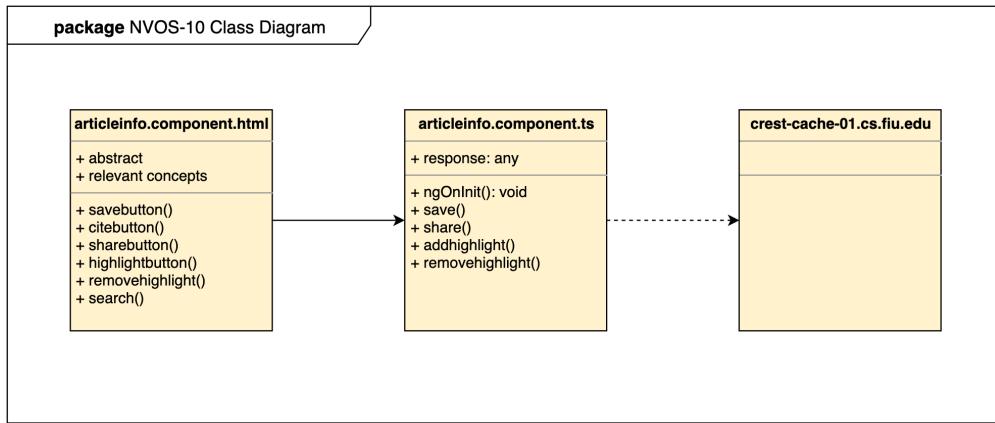
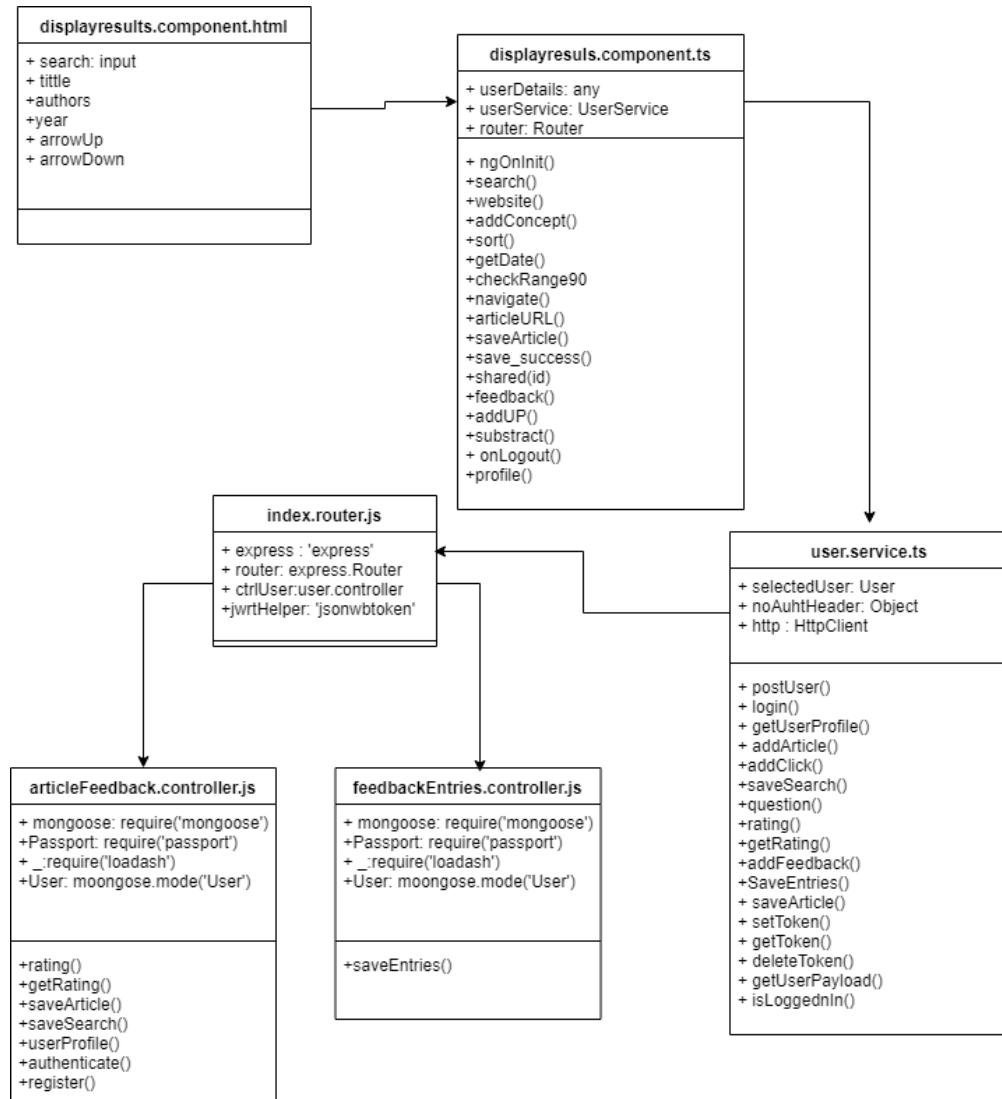


Figure 24: [NVOS-10] Visualization of Text Class Diagram

**Figure 25:** [NVOS-34] Article Feedback Class Diagram

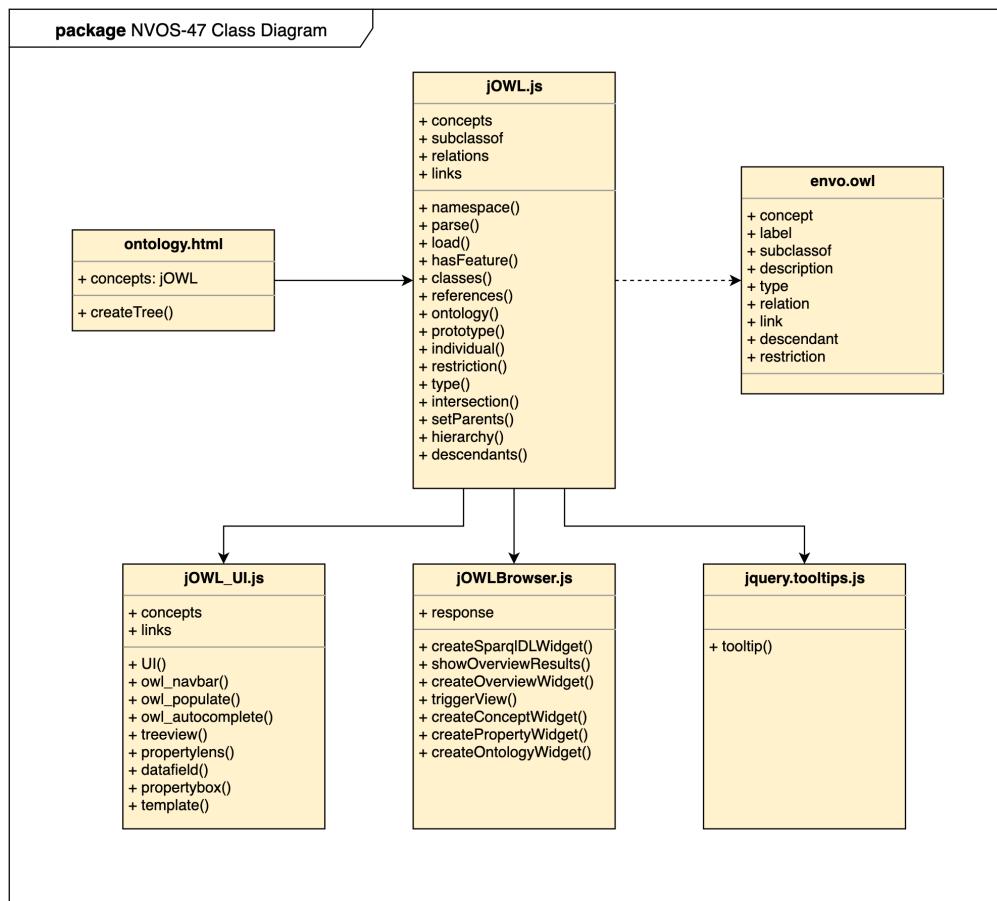
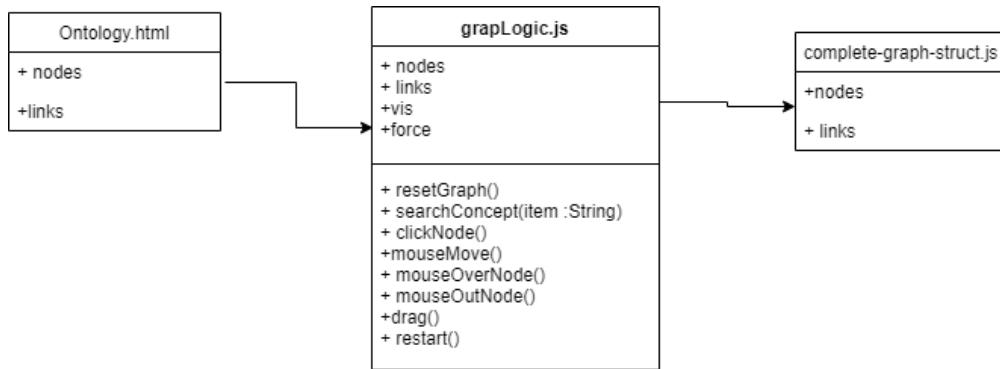
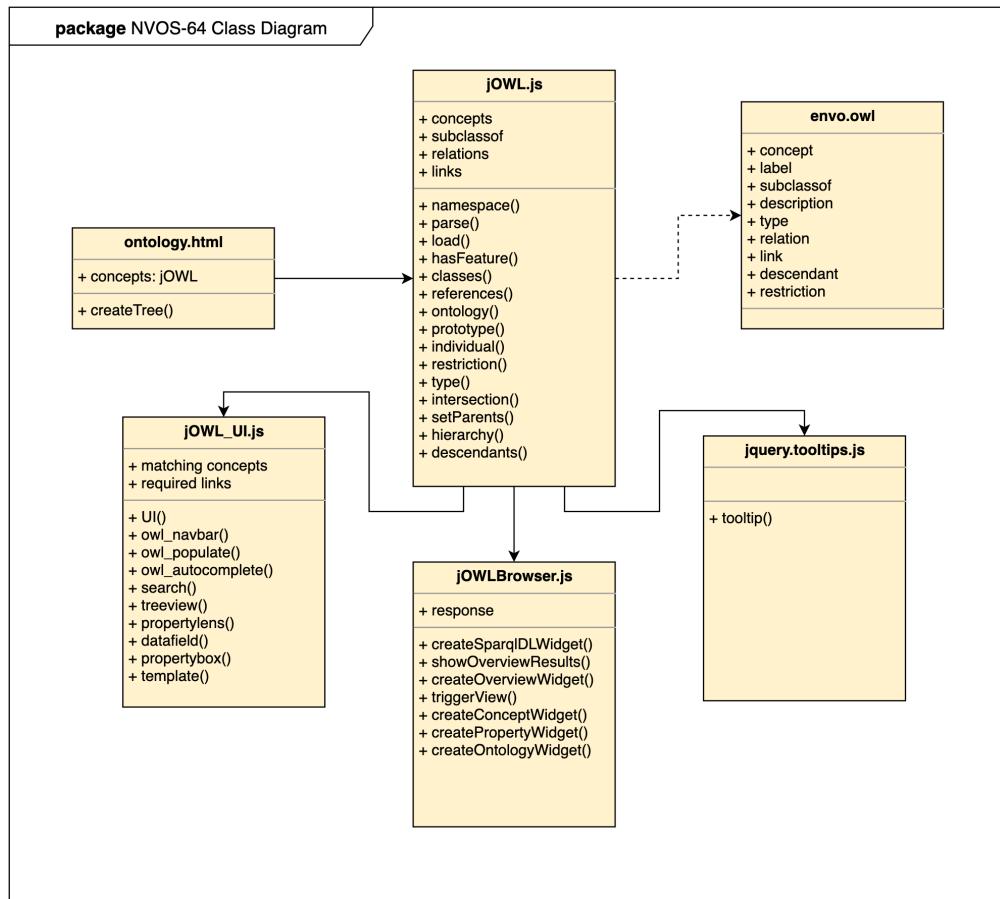
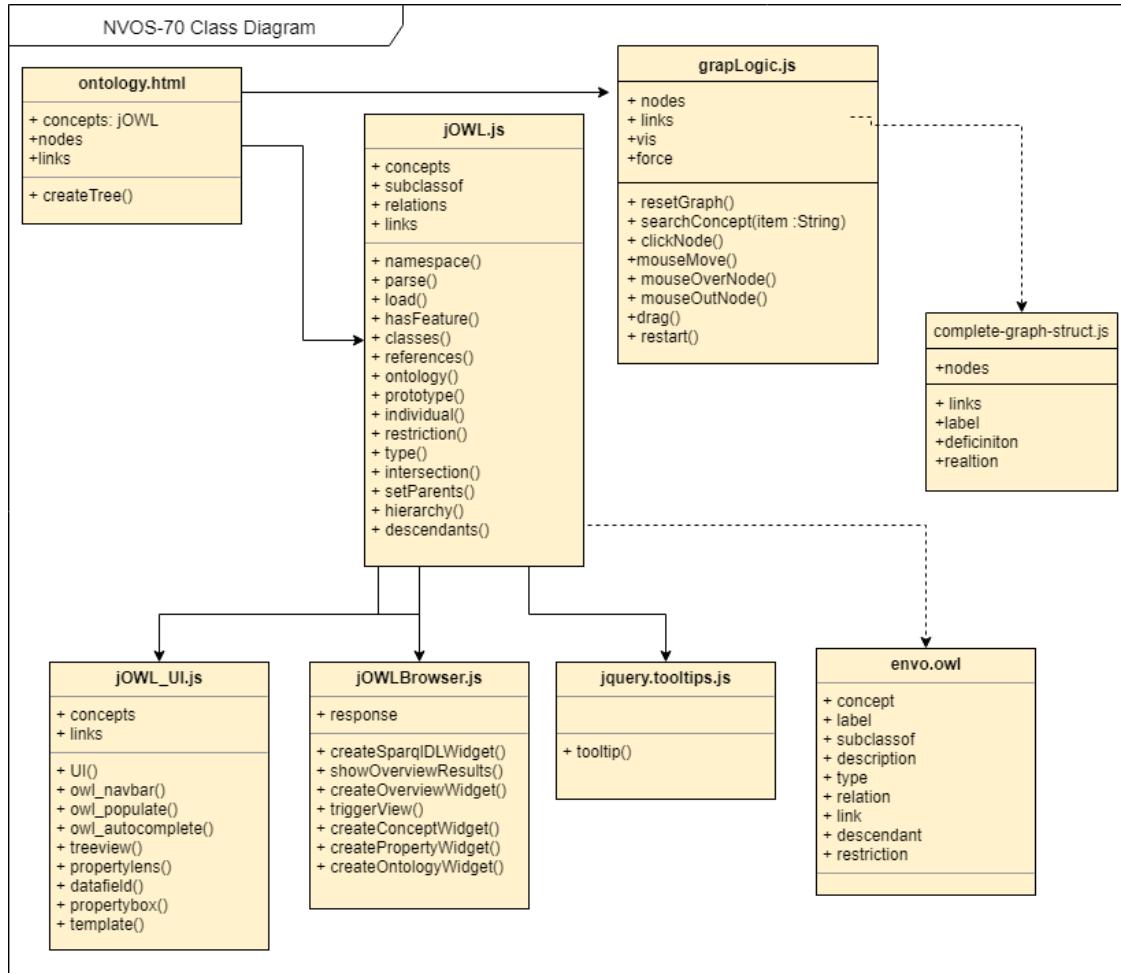
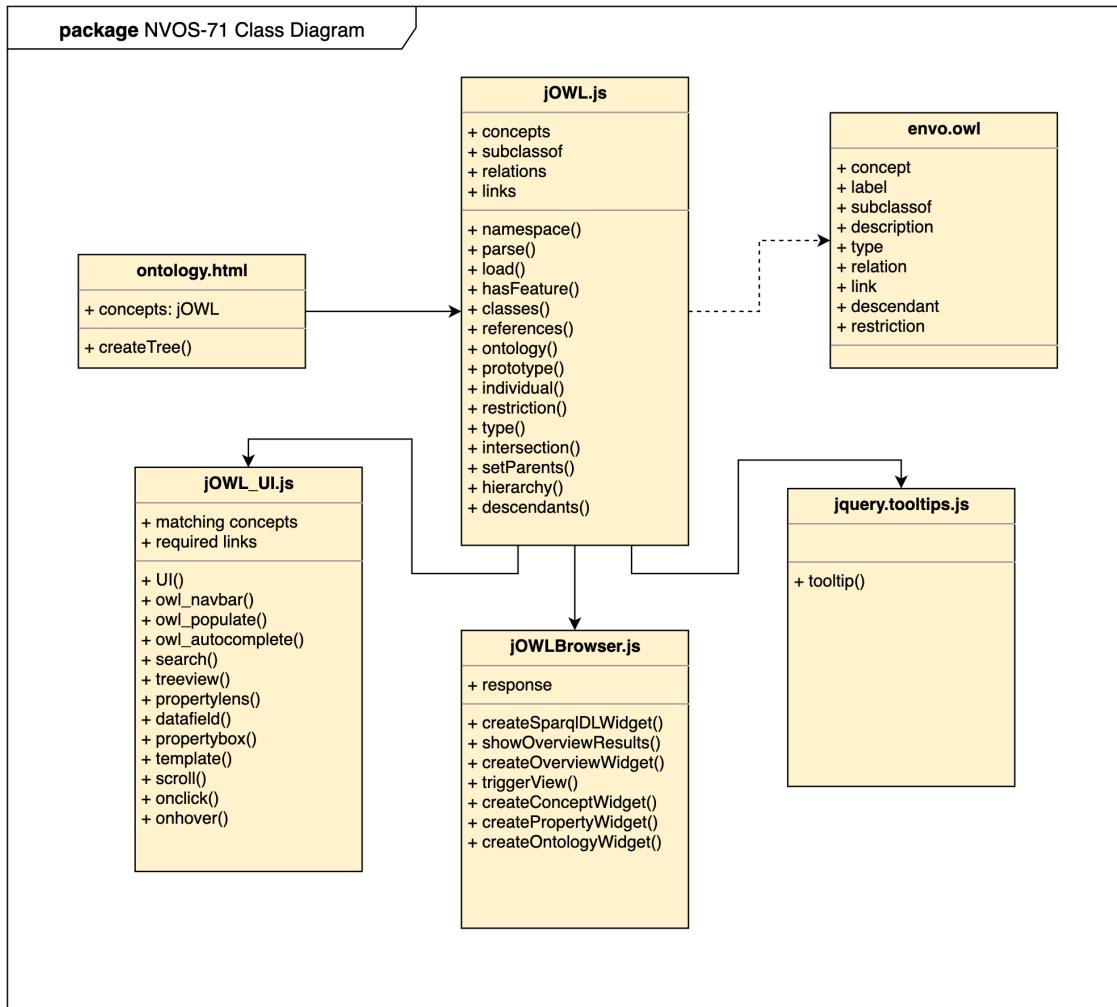


Figure 26: [NVOS-47] Tree Visualization Class Diagram

**Figure 27:** [NVOS-48] Graph Node Visualization Class Diagram**Figure 28:** [NVOS-64] Dynamic Search in Tree Class Diagram

**Figure 29:** [NVOS-70] Unifying Visualization Results Class Diagram

**Figure 30:** [NVOS-71] Enhance Treeview Search Results Class Diagram

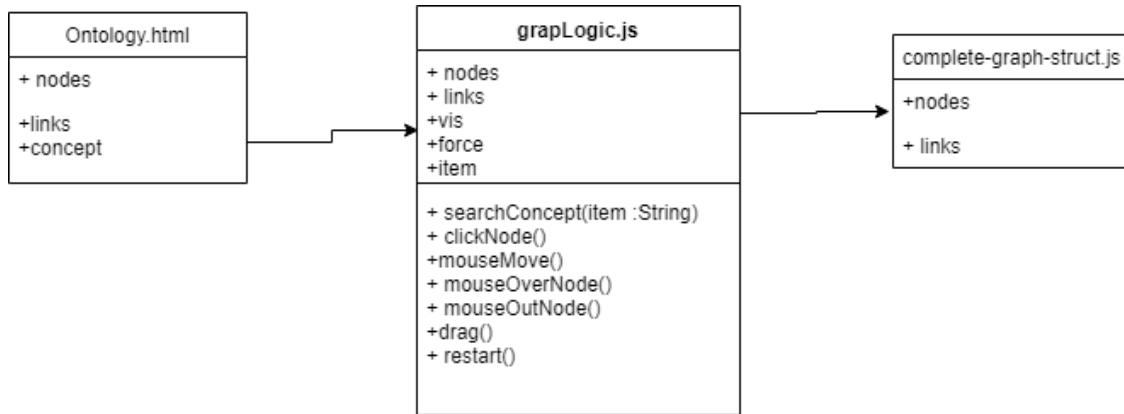


Figure 31: [NVOS-72] Node Graph Search Class Diagram

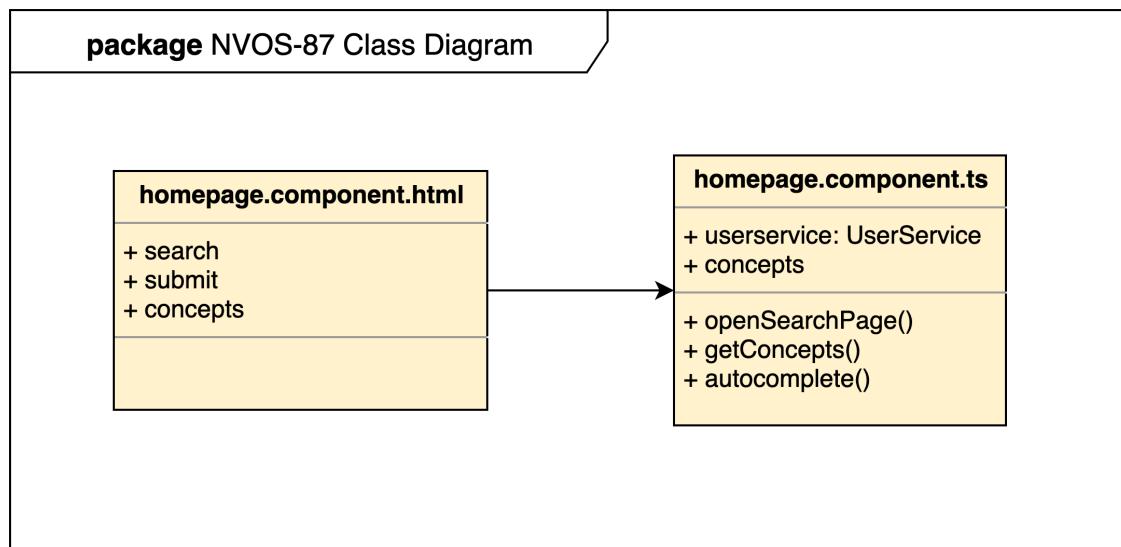
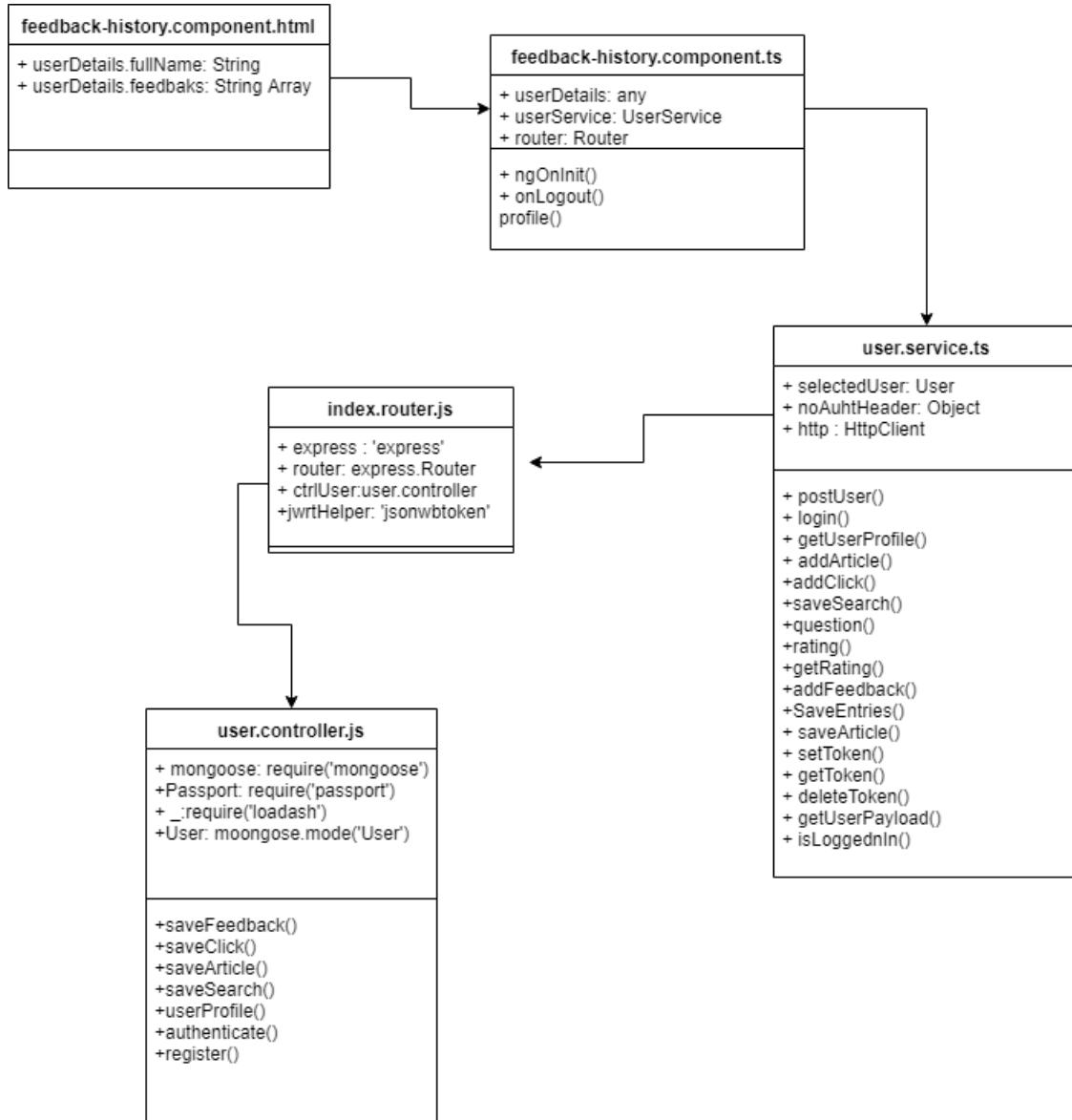


Figure 32: [NVOS-87] Autocomplete Search Class Diagram

**Figure 33:** [NVOS-97] Feedback History Page Class Diagram

6.2 Appendix B - User Interface Design

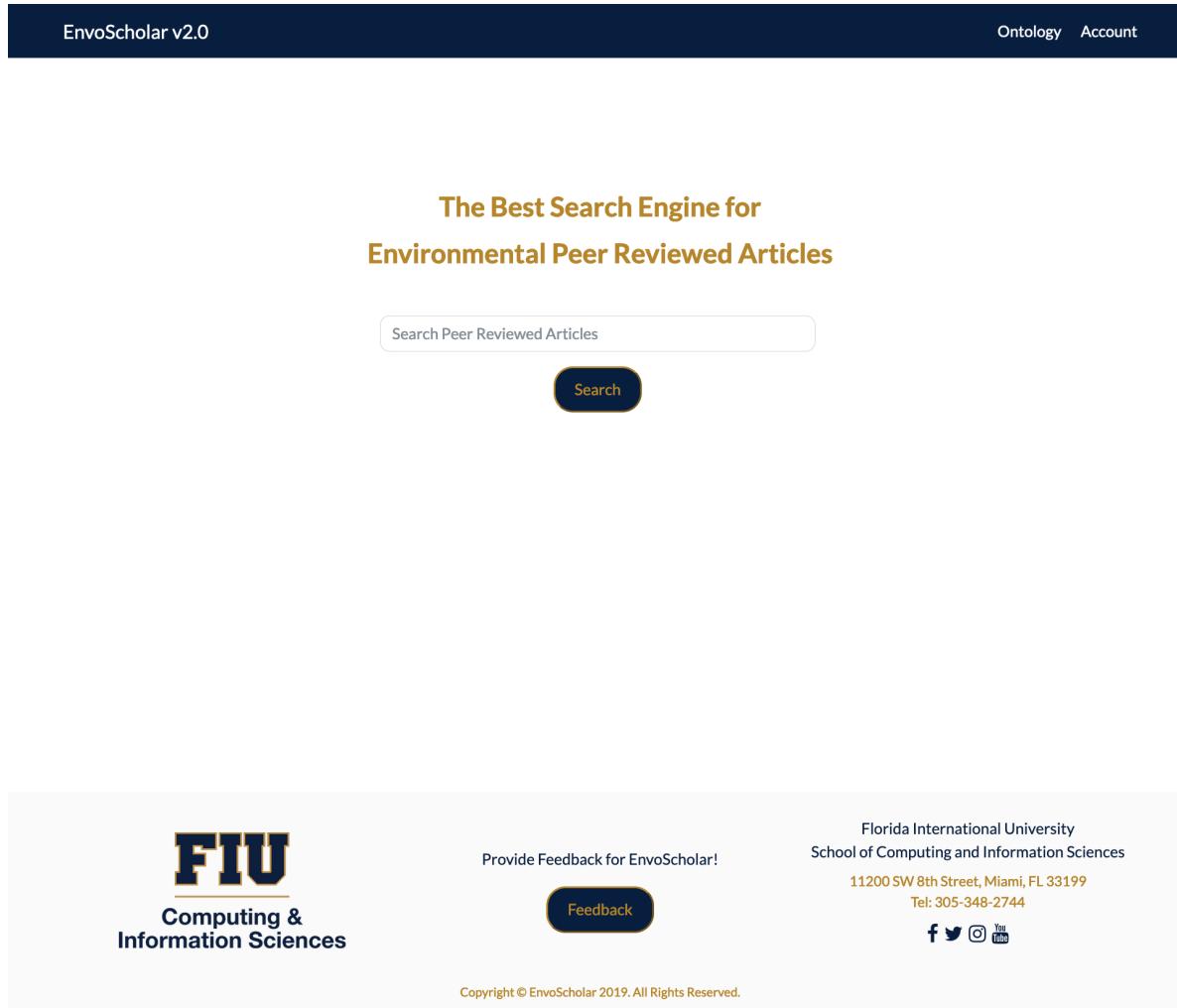


Figure 34: Initial Homepage

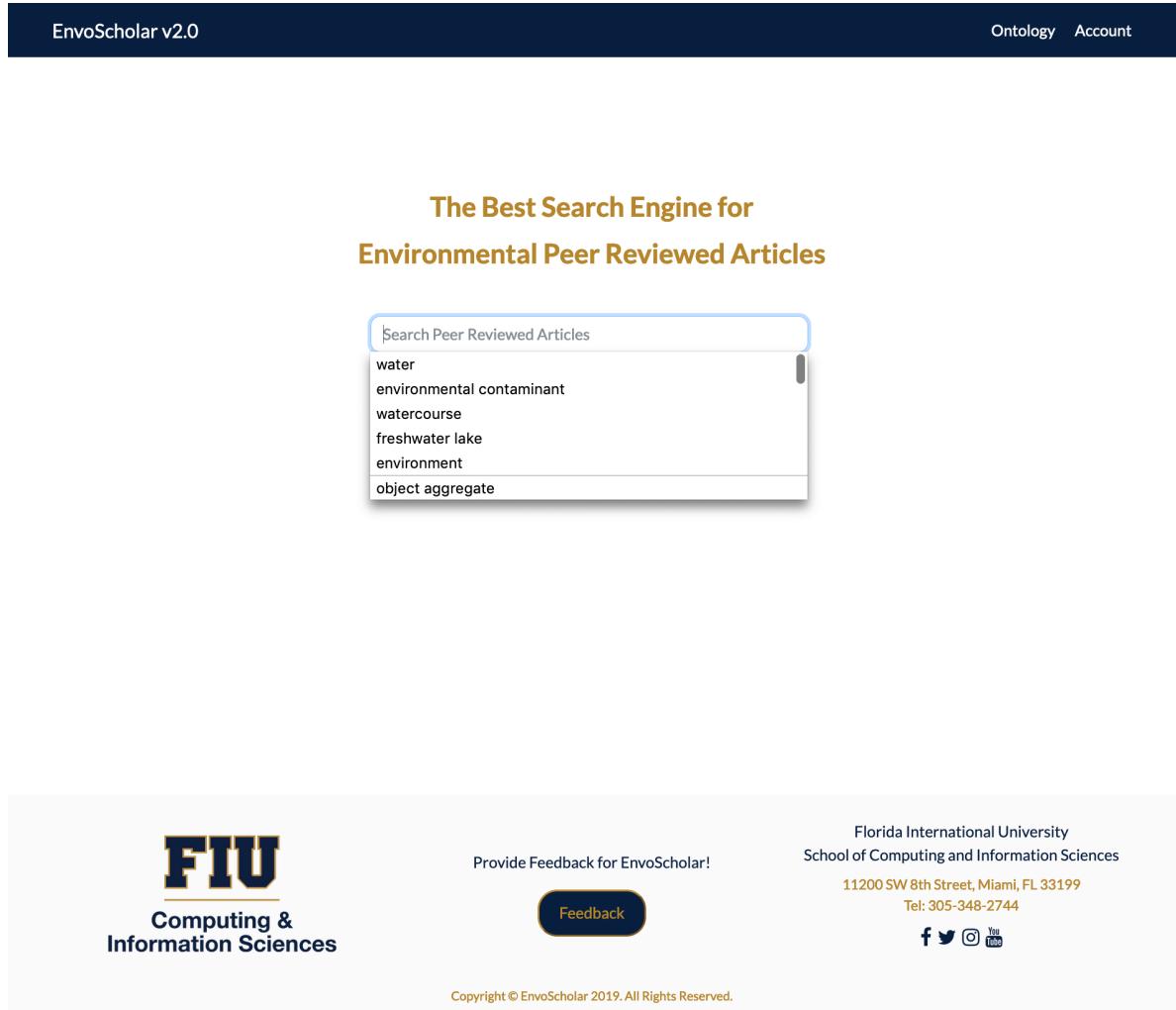


Figure 35: Homepage with Initial Autocomplete Search

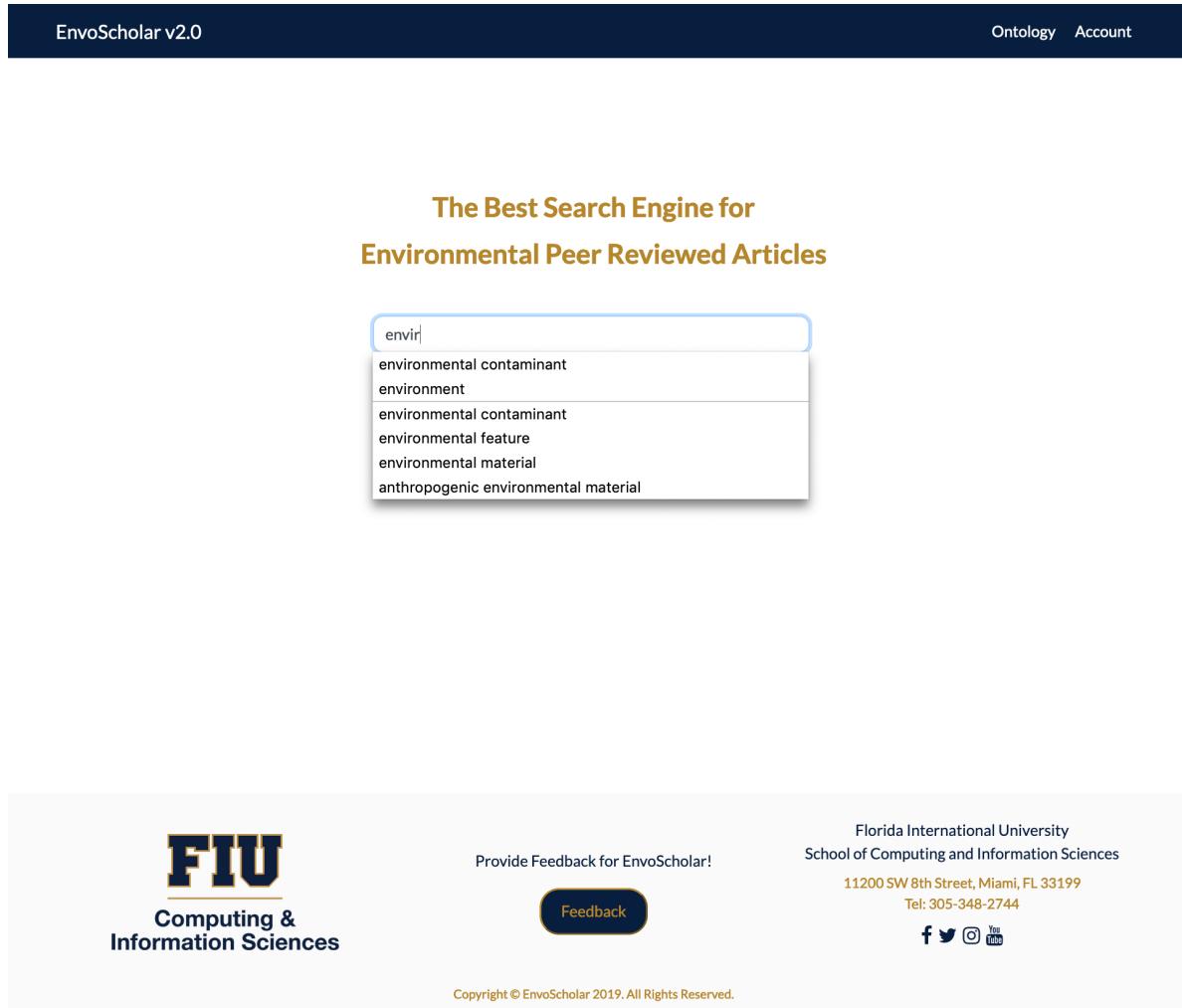


Figure 36: Homepage with Autocomplete Search While Typing

The screenshot shows the EnvoScholar v2.0 interface. At the top, there is a dark header bar with the text "EnvoScholar v2.0" on the left and "Ontology Account" on the right. Below the header, a yellow banner says "You could also search for..." followed by several search terms: air, amazon river, water, sediment, water, and pahs. Underneath the banner, there are five article cards, each with a title, author(s), and a brief abstract. To the right of the cards is a sidebar with search, date range, sort by, and clear filters options.

Search

water

Date Range

1900 - 2018

Sort By

Relevance (selected) | Most Recent

Clear Filters

Article Cards:

- A review of potentially low-cost sorbents for heavy metals**
Patrick S. Bäuerlein-Erik Emke-Peter Tromp-1999-08-31
The use of low-cost sorbents has been investigated as a replacement for current costly methods of removing heavy metals from solution. Natural materials or waste products from certain industries with ...
View PDF | Cite | Save | Share
- Mercury distribution and exchanges between the Amazon River and connected floodplain lakes**
Poliana Dutra Maia-Laurence Maurice-Emmanuel Tessier-2009-11-15
This work presents the distribution and the partition of mercury (Hg) in the Curuai floodplain lakes along the Amazon River. The maximum Total Filtered Hg (T-FHg) concentrations in the floodplain lake...
View PDF | Cite | Save | Share
- Is there evidence for man-made nanoparticles in the Dutch environment?**
Susan E. Bailey-2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...
View PDF | Cite | Save | Share
- Contamination status of arsenic and other trace elements in drinking water and residents from Tarkwa, a historic mining township in Ghana**
A. Atkins-A. Atkins-K Maskaoui-2007-01-31
This study was conducted to assess the contamination status of 22 trace elements, especially As in water and residents in Tarkwa, a historic mining town in Ghana. Drinking water and human urine sample...
View PDF | Cite | Save | Share
- Occurrence patterns of pharmaceutical residues in wastewater, surface water and groundwater of Nairobi and Kisumu city, Kenya**
M LacayoR-M LacayoR-Maria Teresa Alvarez-2016-04-30

Figure 37: Search Results with Article Details

The screenshot shows the EnvoScholar v2.0 interface. At the top, there is a dark header bar with the text "EnvoScholar v2.0" on the left and "Ontology Account" on the right. Below the header, a yellow banner displays the text "You could also search for..." followed by several search suggestions: "environment", "natural environment", "environment", "environment", "nutrient-poor environment", and "wastewater treatment plant". Underneath the banner, there are two rows of search results. Each result card includes an upvote/downvote icon, a title, the author(s) and date, a brief abstract, and download/share/cite/save options. To the right of the results, there is a sidebar with search, date range, sort by, and clear filters options.

You could also search for...

environment natural environment environment environment nutrient-poor environment wastewater treatment plant

[View Results In Microsoft Academic](#) [View Results In Semantic Scholar](#)

Removal of antibiotics in conventional and advanced wastewater treatment: Implications for environmental discharge and wastewater recycling
S.D. Costanzo-2007-10-31
Removal of 28 human and veterinary antibiotics was assessed in a conventional (activated sludge) and advanced (microfiltration/reverse osmosis) wastewater treatment plant (WWTP) in Brisbane, Australia...
[View PDF](#) [Cite](#) [Saved!](#) [Share](#)

Sulfadimethoxine and sulfaguanidine: Their sorption potential on natural soils
Jolanta Kumirska-Piotr Stepnowski-Richard Palavinskas-2012-03-31
Sulfonamides (SAs) are one of the oldest groups of veterinary chemotherapeutic agents. As these compounds are not completely metabolized in animals, a high proportion of the native form is excreted in...
[View PDF](#) [Cite](#) [Save](#) [Share](#)

The prevalence of toxic hotspots in former Soviet countries
Mogi Gogishvili-Mogi Gogishvili-Mogi Gogishvili-2016-04-30
Using a global database of contaminated sites, toxic hotspots in eight former Soviet countries were analyzed to identify the prevalence, types and sources of toxic pollution, as well as their associat...
[View PDF](#) [Cite](#) [Save](#) [Share](#)

Processes for the elimination of estrogenic steroid hormones from water: A review
Oliver R. Price-2012-06-30
Natural estrogens such as estrone (E1), 17 β -estradiol (E2), estriol (E3), and the synthetic one, 17 α -ethinylestradiol (EE2), are excreted by humans and animals and enter into environment through disch...
[View PDF](#) [Cite](#) [Save](#) [Share](#)

Efficient mineral weathering is a distinctive functional trait of the bacterial

Search
environment [Search](#)

Date Range
1900 2018 [Filter Date Range](#)

Sort By
[Relevance](#) [Most Recent](#) [Clear Filters](#)

Figure 38: Search Results with User Feedback and Saved Article

EnvoScholar v2.0 Ontology Account

Is there evidence for man-made nanoparticles in the Dutch environment?

Patrick S. Bäuerlein - Erik Enke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 2017-01-15

Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence of nanoparticles. Different types of water were screened for the presence of inorganic (Ag, Au, TiO₂) and organic nanoparticles (C60, C70, [6,6]-phenyl-C61-butyric acid octyl ester, [6,6]-phenyl-C61-butyric acid butyl ester, [6,6]-phenyl-C61-butyric acid methyl ester, [6,6]-bis-phenyl-C61-butyric acid methyl ester, [6,6]-phenyl-C71-butyric acid methyl ester, [6,6]-thienyl-C61-butyric acid methyl ester). Air samples were analysed for the presence of nanoparticulate Mo, Ag, Ce, W, Pd, Pt, Rh, Zn, Ti, Si, B as well as Fe and Cu. ICP-MS, Orbitrap-HRMS, SEM and EDX were used for this survey. Water samples included dune and bank filtrates, surface waters and ground waters as well as influents, effluents and sludge of sewage treatment plants (STPs), and surface waters collected near airports and harbours. Air samples included both urban and rural samples. C60 was detected in air, sewage treatment plants, influents, effluents and sludge, but in no other aqueous samples despite the low detection limit of 0.1ng/L. C70 and functionalised fullerenes were not detected at all. In STP sludge and influent the occurrence of Ag and Au nanoparticles was verified by SEM/EDX and ICP-MS. In air up to about 25m% of certain metals was found in the nanosize fraction. Overall, between 1 and 6% of the total mass from metals in the air samples was found in the size fraction <100nm

[View PDF](#) [Cite](#) [Save](#) [Share](#)

Citations*Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!***Concepts**

air

inorganic

fullerenes

field survey

water

nanoparticles

[Remove Highlight](#)**Search**

Search Peer Reviewed Articles

Figure 39: Initial Selected Article Information Page

EnvoScholar v2.0 Ontology Account

Is there evidence for man-made nanoparticles in the Dutch environment?

Patrick S. Bäuerlein - Erik Enke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 2017-01-15

Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence of nanoparticles. Different types of water were screened for the presence of inorganic (Ag, Au, TiO₂) and organic nanoparticles (C60, C70, [6,6]-phenyl-C61-butyric acid octyl ester, [6,6]-phenyl-C61-butyric acid butyl ester, [6,6]-phenyl-C61-butyric acid methyl ester, [6,6]-bis-phenyl-C61-butyric acid methyl ester, [6,6]-phenyl-C71-butyric acid methyl ester, [6,6]-thienyl-C61-butyric acid methyl ester). Air samples were analysed for the presence of nanoparticulate Mo, Ag, Ce, W, Pd, Pt, Rh, Zn, Ti, Si, B as well as Fe and Cu. ICP-MS, Orbitrap-HRMS, SEM and EDX were used for this survey. Water samples included dune and bank filtrates, surface waters and ground waters as well as influents, effluents and sludge of sewage treatment plants (STPs), and surface waters collected near airports and harbours. Air samples included both urban and rural samples. C60 was detected in air, sewage treatment plants, influents, effluents and sludge, but in no other aqueous samples despite the low detection limit of 0.1ng/L. C70 and functionalised fullerenes were not detected at all. In STP sludge and influent the occurrence of Ag and Au nanoparticles was verified by SEM/EDX and ICP-MS. In air up to about 25m% of certain metals was found in the nanosize fraction. Overall, between 1 and 6% of the total mass from metals in the air samples was found in the size fraction <100nm.

[View PDF](#) [Cite](#) [Save](#) [Share](#)

Citations*Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!**Lorum ipsum dolor sit amet consectetur adipiscing elit.**2000, Lorum ipsum dolor sit amet consectetur**Lorum ipsum dolor sit amet consectetur adipiscing elit. Laboriosam cumque incident dolore quae aperiam iusto facere sit molestias consequuntur explicabo blanditiis expedita, ipsa corporis temporibus officiis placeat, earum pariatur similiqe!***Concepts**

air

inorganic

fullerenes

field survey

water

nanoparticles

[Remove Highlight](#)**Search**

Search Peer Reviewed Articles

Figure 40: Selected Article Information Page with Highlighted Visualization of Text

The screenshot shows the EnvoScholar v2.0 user interface. At the top, there is a dark header bar with the text "EnvoScholar v2.0" on the left and "Ontology Logout" on the right. Below the header, the main content area has a light gray background. The title "Sheila Alemany's Saved Articles" is displayed in bold blue text at the top left of the content area. To the right of the title are three circular buttons labeled "Feedback History", "Click History", and "Search History". The content area lists several saved articles, each with a blue link to the full abstract and a small snippet of text below it. The articles include:

- A review of potentially low-cost sorbents for heavy metals**
Patrick S. Bäuerlein - Erik Emke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 1999-08-31
The use of low-cost sorbents has been investigated as a replacement for current costly methods of removing heavy metals from solution. Natural materials or waste products from certain industries with ...
- Sulfadimethoxine and sulfaguanidine: Their sorption potential on natural soils**
Jolanta Kumirska - Piotr Stepnowski - Richard Palavinskas - Marta Kołodziejska - Agata Bielawska - Wojciech Mrozik - Joanna Maszkowska - Anna Białk-Bielńska - 2012-03-31
Sulfonamides (SAs) are one of the oldest groups of veterinary chemotherapeutic agents. As these compounds are not completely metabolized in animals, a high proportion of the native form is excreted in...
- Is there evidence for man-made nanoparticles in the Dutch environment?**
Patrick S. Bäuerlein - Erik Emke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...
- Mercury distribution and exchanges between the Amazon River and connected floodplain lakes**
Poliana Dutra Maia - Laurence Maurice - Emmanuel Tessier - David Amouroux - Daniel Cossa - Marcela Pérez - Patricia Moreira-Turcq - Isabelle Rhéault - 2009-11-15
This work presents the distribution and the partition of mercury (Hg) in the Curuai floodplain lakes along the Amazon River. The maximum Total Filtered Hg (T-FHg) concentrations in the floodplain lake...
- A review of potentially low-cost sorbents for heavy metals**
Susan E. Bailey - 1999-08-31
The use of low-cost sorbents has been investigated as a replacement for current costly methods of removing heavy metals from solution. Natural materials or waste products from certain industries with ...
- Is there evidence for man-made nanoparticles in the Dutch environment?**
Susan E. Bailey - 2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...
- Contamination status of arsenic and other trace elements in drinking water and residents from Tarkwa, a historic mining township in Ghana**
A. Atkins - A. Atkins - K Maskaoui - K Maskaoui - A. Atkins - A. Atkins - K Maskaoui - 2007-01-31
This study was conducted to assess the contamination status of 22 trace elements, especially As in water and residents in Tarkwa, a historic mining town in Ghana. Drinking water and human urine sample...

At the bottom of the content area, there is a small, partially visible footer line of text.

Figure 41: Initial User Account Page with Saved Articles

EnvoScholar v2.0 Ontology Logout

[Sheila Alemany's Click History](#)

[Profile](#)

Sulfadimethoxine and sulfaguanidine: Their sorption potential on natural soils
Jolanta Kumirska - Piotr Stepnowski - Richard Palavinskas - Marta Kołodziejka - Agata Bielawska - Wojciech Mrozik - Joanna Maszkowska - Anna Białk-Bielńska - 2012-03-31
Sulfonamides (SAs) are one of the oldest groups of veterinary chemotherapeutic agents. As these compounds are not completely metabolized in animals, a high proportion of the native form is excreted in...

Removal of antibiotics in conventional and advanced wastewater treatment: Implications for environmental discharge and wastewater recycling
S.D. Costanzo - 2007-10-31
Removal of 28 human and veterinary antibiotics was assessed in a conventional (activated sludge) and advanced (microfiltration/reverse osmosis) wastewater treatment plant (WWTP) in Brisbane, Australia...

Impact of the disposal and re-use of fly ash on water quality: The case of the Koradi and Khaperkheda thermal power plants (Maharashtra, India)
M. Spadoni - M. Voltaggio - E. Sacchi - R. Sanam - P.R. Pujari - C. Padmakar - P.K. Labhasetwar - S.R. Wate - 2014-05-01
An increasing amount of fly ash from thermal power plants is produced in India every year. Its disposal is generally done in ponds after it is mixed together in suitable proportion of water to form a ...

Mercury distribution and exchanges between the Amazon River and connected floodplain lakes
Poliana Dutra Maia - Laurence Maurice - Emmanuel Tessier - David Amouroux - Daniel Cossa - Marcela Pérez - Patricia Moreira-Turcq - Isabelle Rhéault - 2009-11-15
This work presents the distribution and the partition of mercury (Hg) in the Curuai floodplain lakes along the Amazon River. The maximum Total Filtered Hg (T-FHg) concentrations in the floodplain lake...

Investigating a high ozone episode in a rural mountain site
A. Monteiro - A. Strunk - A. Carvalho - O. Tchepel - A.I. Miranda - C. Borrego - S. Saavedra - A. Rodriguez - J. Souto - J. Casares - E. Friese - H. Elbern - 2012-03-31
A very high ozone episode with observed hourly values above $350 \mu\text{g m}^{-3}$ occurred in July 2005 at the Lamas d'Olo air quality monitoring station, located in a mountainous area in the north of Portugal ...

Is there evidence for man-made nanoparticles in the Dutch environment?
Patrick S. Bäuerlein - Erik Emke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P.van Wezel - 2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...

Figure 42: User Account with Click History Page

EnvoScholar v2.0 Ontology Logout Profile

Sheila Alemany's Feedback History

A review of potentially low-cost sorbents for heavy metals
Patrick S. Bäuerlein - Erik Emke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 1999-08-31
The use of low-cost sorbents has been investigated as a replacement for current costly methods of removing heavy metals from solution. Natural materials or waste products from certain industries with ...

Mercury distribution and exchanges between the Amazon River and connected floodplain lakes
Poliana Dutra Maia - Laurence Maurice - Emmanuel Tessier - David Amouroux - Daniel Cossa - Marcela Pérez - Patricia Moreira-Turcq - Isabelle Rhéault - 2009-11-15
This work presents the distribution and the partition of mercury (Hg) in the Curuai floodplain lakes along the Amazon River. The maximum Total Filtered Hg (T-FHg) concentrations in the floodplain lake...

Is there evidence for man-made nanoparticles in the Dutch environment?
Susan E. Bailey - 2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...

Mercury distribution and exchanges between the Amazon River and connected floodplain lakes
Poliana Dutra Maia - Laurence Maurice - Emmanuel Tessier - David Amouroux - Daniel Cossa - Marcela Pérez - Patricia Moreira-Turcq - Isabelle Rhéault - 2009-11-15
This work presents the distribution and the partition of mercury (Hg) in the Curuai floodplain lakes along the Amazon River. The maximum Total Filtered Hg (T-FHg) concentrations in the floodplain lake...

A review of potentially low-cost sorbents for heavy metals
Patrick S. Bäuerlein - Erik Emke - Peter Tromp - Jan A.M.H. Hofman - Andrea Carboni - Ferry Schooneman - Pim de Voogt - Annemarie P. van Wezel - 1999-08-31
The use of low-cost sorbents has been investigated as a replacement for current costly methods of removing heavy metals from solution. Natural materials or waste products from certain industries with ...

Is there evidence for man-made nanoparticles in the Dutch environment?
Susan E. Bailey - 2017-01-15
Only very limited information is available on measured environmental concentrations of nanoparticles. In this study, several environmental compartments in The Netherlands were probed for the presence ...

Dense mats of thioploca, gliding filamentous sulfur-oxidizing bacteria in lake Biwa, central Japan
Machiko Nishino - 1998-03-01

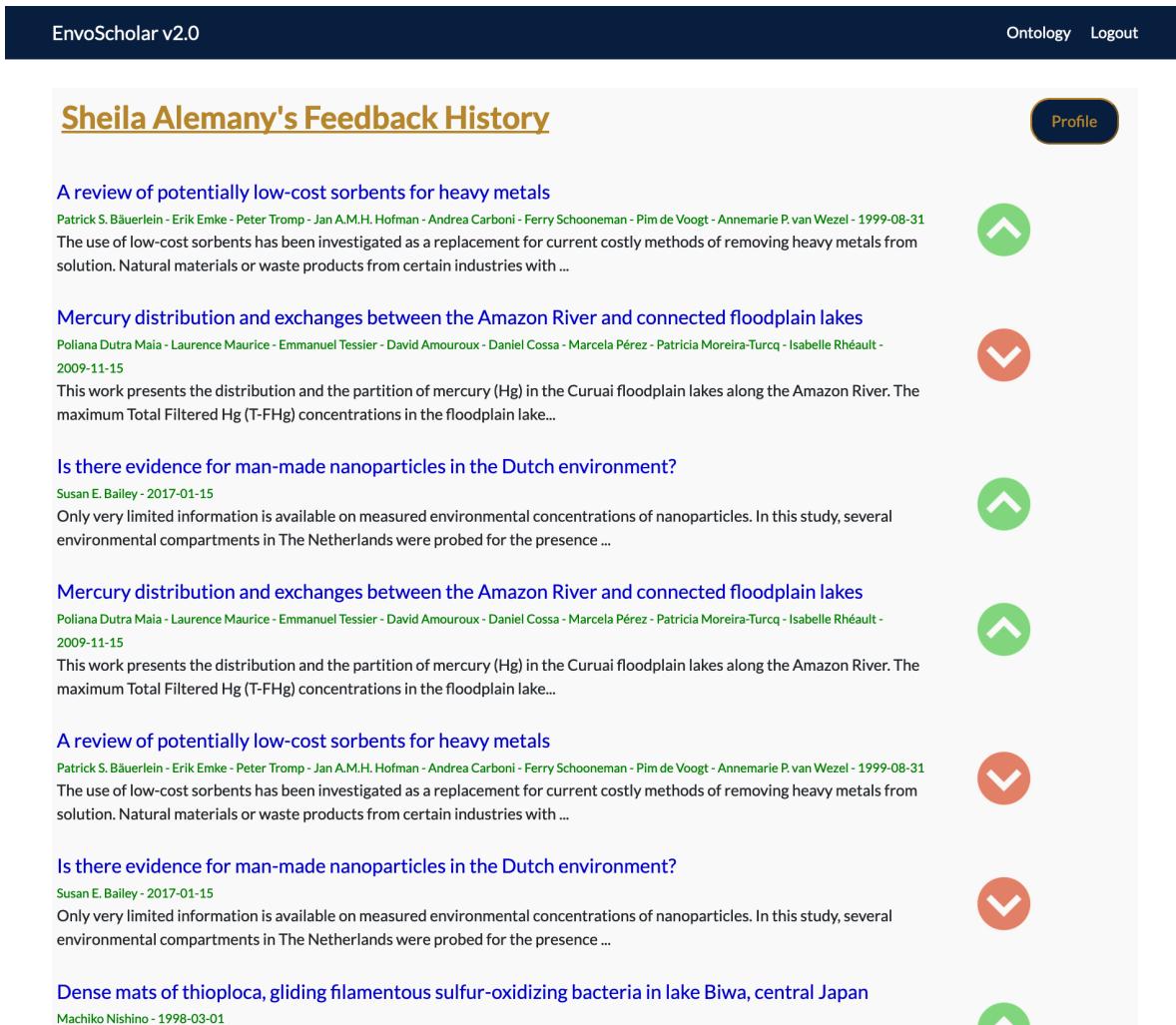


Figure 43: User Account with Feedback History Page

EnvoScholar v2.0

Ontology Account

Environment Ontology

- ENVO is an ontology which represents knowledge about environments, environmental processes, ecosystems, habitats, and related entities. It interoperates with other ontologies in the OBO Foundry and Library.
- New terms or revisions can be requested at <https://github.com/EnvironmentOntology/envo/issues/>.
- Original file available at <http://www.obofoundry.org/ontology/envo.html>.

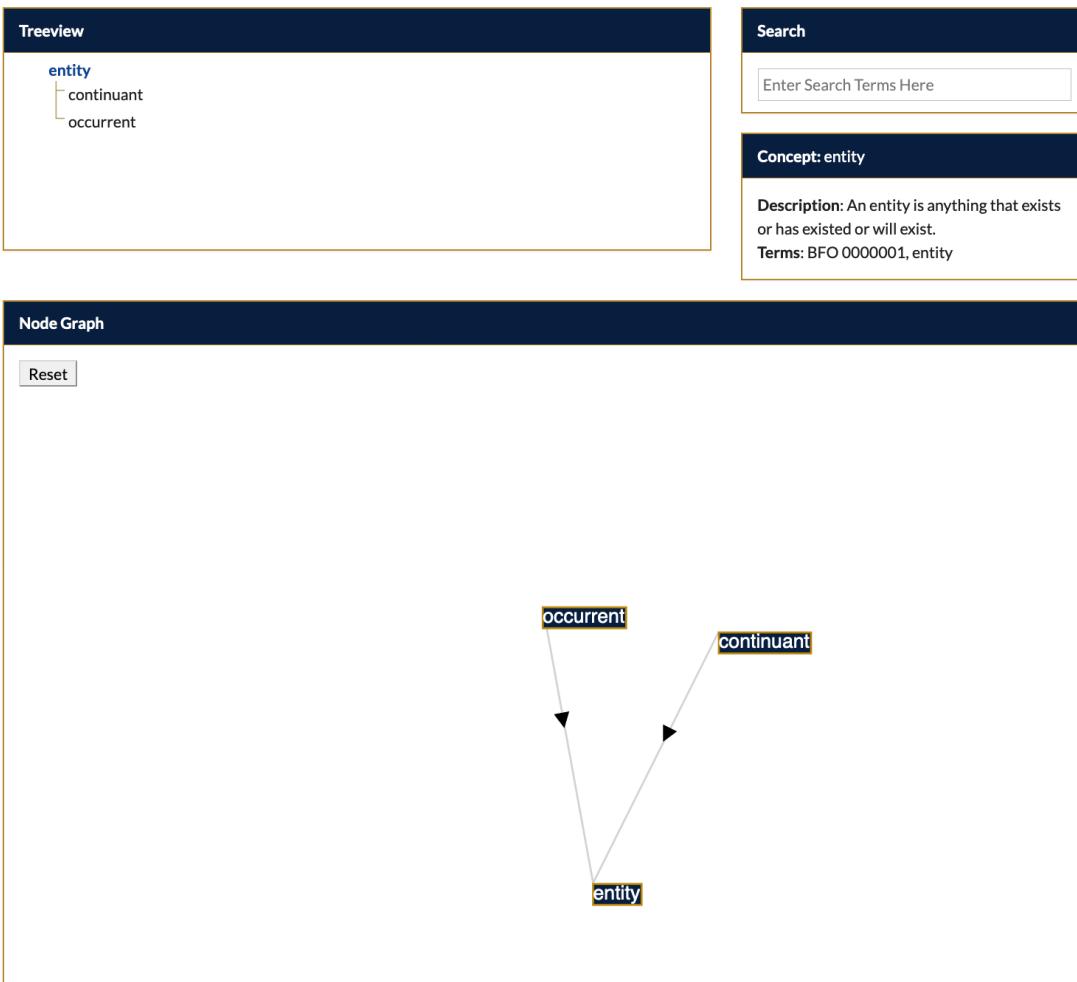


Figure 44: Initial Ontology Visualization Page

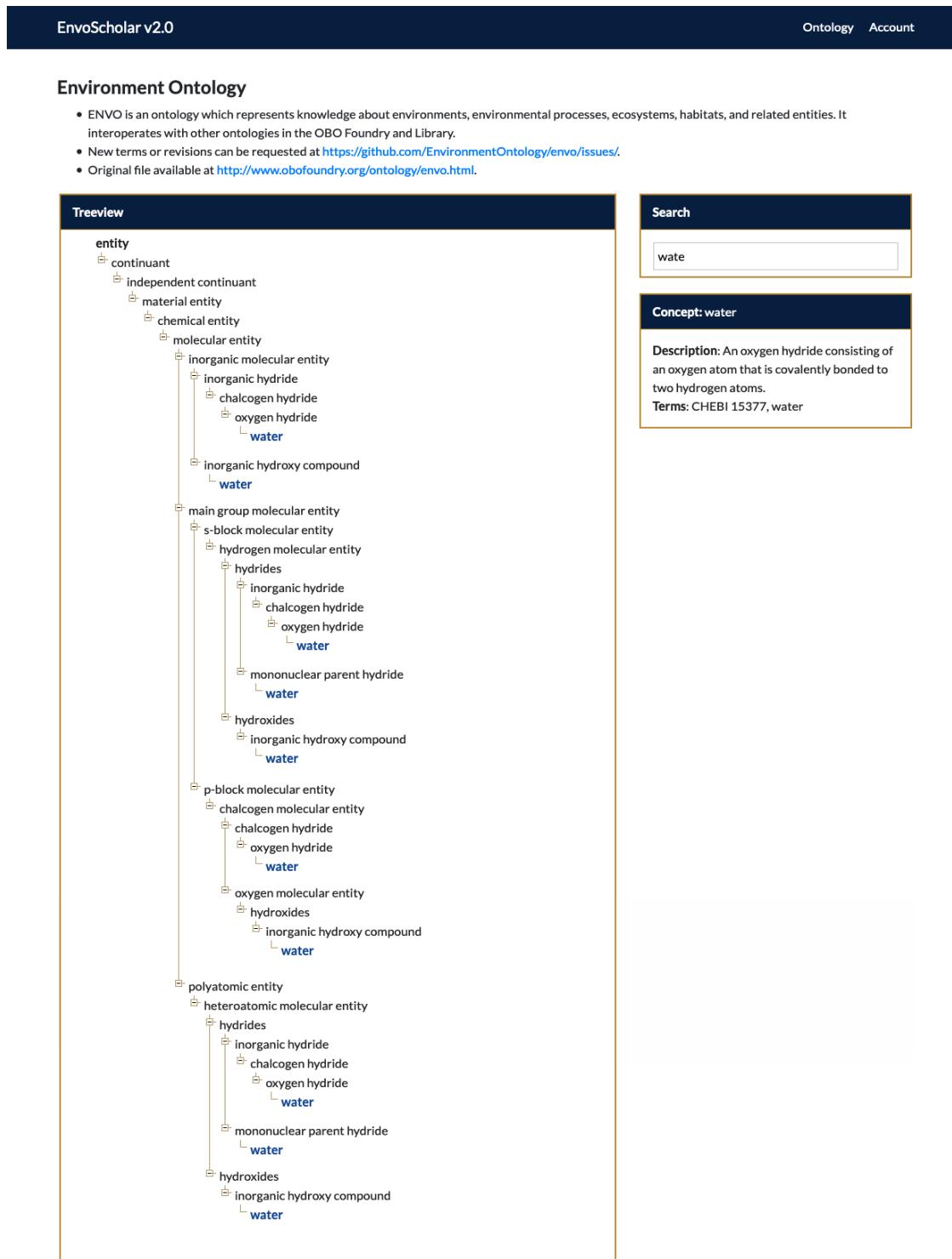


Figure 45: Ontology Treeview Visualization with Concept Relationship

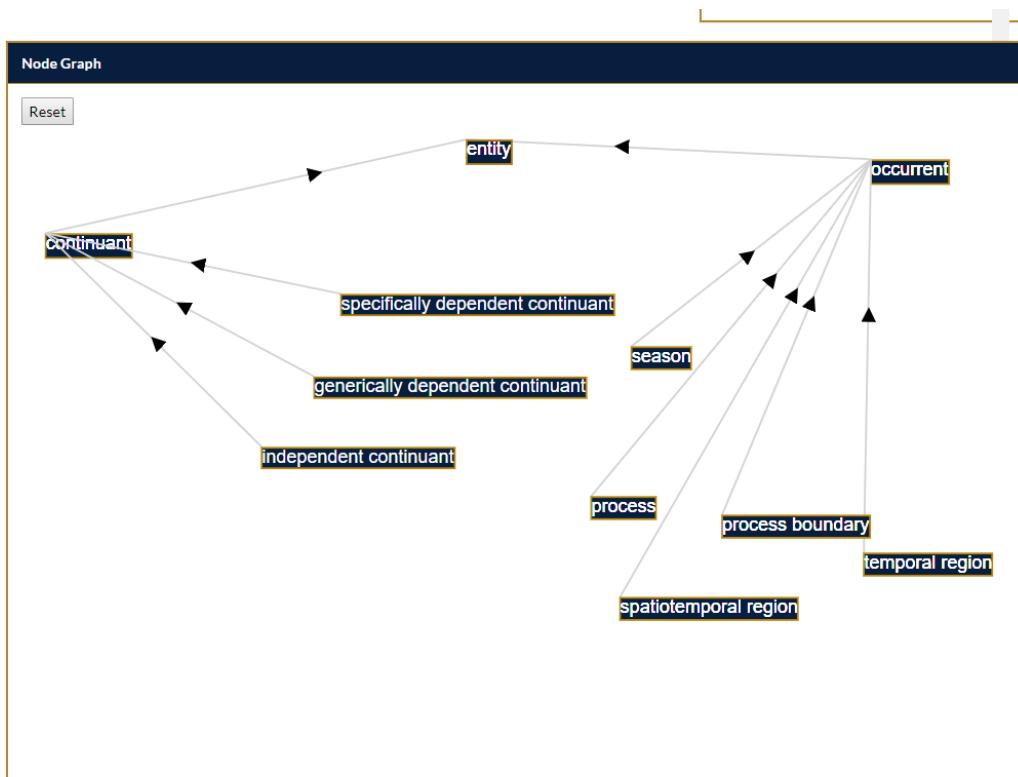


Figure 46: Ontology Node Graph Visualization with Concept Relationship

EnvoScholar v2.0 Ontology Account

Environment Ontology

- ENVO is an ontology which represents knowledge about environments, environmental processes, ecosystems, habitats, and related entities. It interoperates with other ontologies in the OBO Foundry and Library.
- New terms or revisions can be requested at <https://github.com/EnvironmentOntology/envo/issues/>.
- Original file available at <http://www.obofoundry.org/ontology/envo.html>.

Treeview

```

entity
└── continuant
    └── specifically dependent continuant
        └── quality
            ├── information carrier
            ├── morphology
            ├── mass
            └── organismal quality

```

Search

qua	quality	owl:Class
quality	qua	owl:Class
sand pit quarry	quality	owl:Class
aqueduct	sand pit quarry	owl:Class
obsolete aquatic habitat	aqueduct	owl:Class
quarry	obsolete aquatic habitat	owl:Class
aquatic biome	quarry	owl:Class
aquarium	aquatic biome	owl:Class
saline water aquarium	aquarium	owl:Class

Node Graph

Reset

```

graph TD
    length --> quality
    quality --> organismalQuality[organismal quality]
    quality --> morphology[morphology]
    quality --> mass[mass]
    quality --> informationCarrier[information carrier]

```

Figure 47: Ontology with Graph Node and Treeview and Concept Search

6.3 Appendix C - Sprint Review Reports

6.3.1 Sprint 1

Date: February 1, 2019

Attendees: Sheila Alemany, Carlos Bravo, Deya Banisakher

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- Task NVOS-45 Parse/Restructure Data [\[NVOS-45 Jira Link\]](#)
- Task NVOS-44 Implement Rough Tree Visualization [\[NVOS-44 Jira Link\]](#)
- Task NVOS-43 Implement Rough Node Graph Visualization [\[NVOS-43 Jira Link\]](#)

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- None of the user stories or tasks were rejected or moved back to the product backlog to be assigned to a future sprint.

6.3.2 Sprint 2

Date: February 15, 2019

Attendees: Sheila Alemany, Carlos Bravo, Maria E. Presa Reyes, Mark Finlayson

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- User Story NVOS-47 Tree Visualization [\[NVOS-47 Jira Link\]](#)

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- User Story NVOS-48 Node Graph Visualization [\[NVOS-48 Jira Link\]](#)

6.3.3 Sprint 3

Date: March 1, 2019

Attendees: Sheila Alemany, Carlos Bravo, Deya Banisakher

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- User Story NVOS-48 Node Graph Visualization [[NVOS-48 Jira Link](#)]
- User Story NVOS-64 Dynamic Search in Tree [[NVOS-64 Jira Link](#)]
- User Story NVOS-51 Tree Visualization in Microsoft Edge [[NVOS-51 Jira Link](#)]
- User Story NVOS-54 Node Graph Visualization in Safari [[NVOS-54 Jira Link](#)]
- User Story NVOS-63 Article Search [[NVOS-63 Jira Link](#)]

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- User Story NVOS-10 Visualization on Text [[NVOS-10 Jira Link](#)] (We will be changing the initial visualization of the text technique.)

6.3.4 Sprint 4

Date: March 8, 2019

Attendees: Sheila Alemany, Carlos Bravo, Deya Banisakher, Mark Finlayson

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- User Story NVOS-72 Node Graph Search [[NVOS-72 Jira Link](#)]
- User Story NVOS-10 Visualization of Text [[NVOS-10 Jira Link](#)]

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- User Story NVOS-71 Enhance Treeview Search Results [[NVOS-71 Jira Link](#)]

6.3.5 Sprint 5

Date: March 29, 2019

Attendees: Sheila Alemany, Carlos Bravo, Deya Banisakher, Mark Finlayson, Maria E. Presa Reyes

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- User Story NVOS-10 Visualization of Text [\[NVOS-10 Jira Link\]](#)
- Bug NVOS-78 Fix Search Bar [\[NVOS-78 Jira Link\]](#)
- Bug NVOS-79 Fix Article Selection [\[NVOS-79 Jira Link\]](#)
- Bug NVOS-80 Fix Slow Loading Pages [\[NVOS-80 Jira Link\]](#)
- Bug NVOS-81 Fix Logout Button [\[NVOS-81 Jira Link\]](#)
- Bug NVOS-82 Fix Saved Button [\[NVOS-82 Jira Link\]](#)
- Bug NVOS-83 Fix Share Button [\[NVOS-83 Jira Link\]](#)
- Bug NVOS-84 Fix Footer [\[NVOS-84 Jira Link\]](#)

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- User Story NVOS-70 Unifying Visualization [\[NVOS-70 Jira Link\]](#)
- User Story NVOS-71 Enhance Treeview Search Results [\[NVOS-71 Jira Link\]](#)
- User Story NVOS-34 Articles Feedback [\[NVOS-34 Jira Link\]](#)

6.3.6 Sprint 6

Date: April 12, 2019

Attendees: Sheila Alemany, Carlos Bravo, Deya Banisakher, Mark Finlayson, Maria E. Presa Reyes

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following tasks were accepted by the product owners: All.

- User Story NVOS-70 Unifying Visualization [[NVOS-70 Jira Link](#)]
- User Story NVOS-34 Feedback [[NVOS-34 Jira Link](#)]
- User Story NVOS-71 Enhance Treeview Search Results [[NVOS-71 Jira Link](#)]
- User Story NVOS-87 Autocomplete Search [[NVOS-87 Jira Link](#)]
- User Story NVOS-97 Feedback History on User Profile [[NVOS-97 Jira Link](#)]

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

- None of the user stories or tasks were rejected or moved back to the product backlog to be assigned to a future sprint.

6.3.7 Sprint 7

Date: April 19, 2019

Attendees: Sheila Alemany, Carlos Bravo

Start time: 1:30 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following documents were accepted:

- Final documentation
- Powerpoint presentation
- Posters
- Final version of code into the dev branch
- Recorded videos: Introduction video, user guide, installation video, shortcoming video

6.4 Appendix D - User Manuals, Installation/Maintenance Document, and Shortcomings/Wishlist Document, and Other Documents

6.4.1 User Manuals

There is one type of user of the system developed in this project, that is, researchers in the field of environmental science. Below is a description of how these this type of users can use the system.

1. Search on homepage with autocomplete
 - (a) Open the EnvoScholar website
 - (b) Double click on the search bar to see a list of concepts from the ENVO ontology
 - (c) Begin typing a string and see a list of potential matching concepts from the ENVO ontology
 - (d) Click on the concept or finish typing the concept into the search bar
 - (e) Press the Submit button or press Enter on your keyboard
2. Change search with related concept
 - (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on any of the concepts on top of the display results page to refresh the search results
3. Compare results with common academic search engines
 - (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the View Results in Microsoft Academic or View Results in Microsoft Academic buttons
4. View PDF of an article
 - (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the View PDF button
5. Log in to account
 - (a) On the navigation bar, click on Account
 - (b) Input account email and password
 - (c) Click on the Sign in button
6. Create an account
 - (a) On the navigation bar, click on Account
 - (b) Click on Sign up
 - (c) Input full name, account email, and password
 - (d) Click on the Sign up button
7. Save an article

- (a) Once Step 1 and 5 are complete, user is taken to the display results page
 - (b) Click on the Save button
 - (c) See confirmation that the article was properly saved
8. Share an article
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the Share button
 - (c) Select the social media outlet and follow the instructions on the respective social media platform
 - (d) See confirmation that the article was properly shared
9. Provide positive feedback for an article
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the up arrow to the left of the specific article
 - (c) See the arrow turn green to confirm that it has been rated
10. Provide negative feedback for an article
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the down arrow to the left of the specific article
 - (c) See the arrow turn red to confirm that it has been rated
11. Filter search results on display results page
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Enter a date range into the fields the right of the page under the heading Date Range
 - (c) See the page refresh with a more tailored search
12. Sort search results on display results page
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) Click on the Recency or Relevance buttons to sort by Recency or Relevance, respectively
 - (c) See the page refresh with the sorted search
13. Provide feedback for EnvoScholar

- (a) Click on the Feedback button in the footer
 - (b) Answer the question "How do you like the website?" prompted on the screen
 - (c) Click the Ok button
 - (d) Provide a response for the question "Rate your experience: 1-10" prompted on the screen
 - (e) Click the Ok button
14. View information about specific article
- (a) Once Step 1 is complete, user is taken to the display results page
 - (b) The user clicks on their article of choice and is taken to the article information page
 - (c) See the article title, authors, abstract, and same options as in the display results page (i.e., View PDF, Save, Cite, Share buttons)
15. Visualization of text in article information page
- (a) Once Step 14 is complete, user is taken to the article information page
 - (b) The user clicks on any of the concepts listed under the "Concepts" heading
 - (c) See the sentences where that concept exists in the article abstract
16. Remove visualization of text in article information page
- (a) Once Step 15 is complete, user sees highlighted sentences in the abstract
 - (b) Click on the Remove Highlight button
 - (c) See the highlighting disappear
17. View the ontology
- (a) On the navigation bar, click on Ontology
 - (b) See the initial treeview and node graph visualizations with the root concept being "entity"
18. Navigate the ontology
- (a) Once Step 18 is complete, user sees the visualization techniques on the ENVO ontology
 - (b) Click on any of the children in the treeview structure and watch the tree and node graph expand simultaneously
19. Search the ontology

- (a) Once Step 18 is complete, user sees the visualization techniques on the ENVO ontology
- (b) Enter string into the search bar
- (c) See a list of concepts that match the string
- (d) Hover or click on any of the concepts and see the ontology structure shown in both visualization techniques

20. View saved articles

- (a) Once Step 5 is complete, user can click on the Account button and be navigated to their profile
- (b) See the list of saved articles

21. View click history

- (a) Once Step 5 is complete, user can click on the Account button and be navigated to their profile
- (b) Click on the Click History button
- (c) See the list of clicked articles

22. View search articles

- (a) Once Step 5 is complete, user can click on the Account button and be navigated to their profile
- (b) Click on the Search History button
- (c) See the list of searched concepts

23. View feedback history

- (a) Once Step 5 is complete, user can click on the Account button and be navigated to their profile
- (b) Click on the Feedback History button
- (c) See the list of rated articles and their rating values represented by an green up arrow or a red down arrow

6.4.2 Installation/Maintenance Document

This section provides a step-by-step instruction on how to set up development environment and deployment environment. The YouTube video (here) also goes through the steps to install and run EnvoScholar. Prior to using EnvoScholar v2.0, make sure you follow all the steps described below to ensure functionality of all features. Navigate to the nvos-scholar folder. Inside you will find two folders, nvos-scholar and user_database_server. These folders contain all the source code you will need. The user_database_server folder contains all the code for the server and the database.

Angular Frontend

The nvos-scholar folder contains all the source code for the Angular frontend. Inside you will see a folder named `src`. Navigate to that folder. Inside the `src` folder, navigate to the `app` folder. The `app` folder contains all the `component.ts`, HTML, and CSS files. The ontology page was not created using Angular. It was created on a basic HTML page which is found in the `src` folder.

Backend Database Server

Inside the `user_database_server` folder, the three main folders you will be working with if you need to add/change anything in the database are the `controllers`, `models`, and `routes` folders. The `config` folder will probably stay the same, and `server.js` file will also probably not need anything changes/additions. The `server.js` file is the main file in the `user_database_server` folder.

Installation Prerequisites

1. NodeJS: Can be downloaded at the following link: <https://nodejs.org/en/>
2. Angular: Go to the Go into the project folder, NVOS-Scholar, and type

```
$ npm install -g @angular/cli
```

Note: This will allow you to run the command `ng serve` which runs the Angular application. Installing the program should be fairly simple. You should not have to install any libraries because the package `.json` files already have the libraries necessary to run the program. But just in case it does say that any libraries are missing, you can go to either the `nvos-scholar` folder or the `user_database_server` folder and type `npm install`. It will reinstall the libraries necessary. If you're on a Mac and you get any permission conflicts, do `sudo npm install` and type your password when prompted.

3. MongoDB: Can be installed at the following link (for both Windows and MacOS):

<https://www.mongodb.com/download-center/community>

- For Windows 10 specifically, create database directory: The first time you run EnvoScholar you need to create a database directory. Open the command prompt and navigate to the directory you want to save your database. For example, you can do

```
$ cd C:\
```

to go to the root folder in the C drive. Once you choose where you want to create your database. Run in the command prompt:

```
$ md "\data\db"
```

This will create the database directory.

4. Compass: Can be installed at the following link:

<https://www.mongodb.com/download-center/compass>

5. For off-campus access using FIU VPN: Helpful links to connect to the VPN:

<https://network.fiu.edu/vpn/> and

<https://castic.fiu.edu/main/app/core/helpguides/HowtoVPN.pdf>

Run EnvoScholar v2.0

Open 3 terminals.

With the first terminal, navigate to the nvos-scholar folder. Run the command:

```
$ ng serve --aot
```

After this finishes compiling, open your web browser of choice and open the Angular based frontend on `localhost:4200`.

Once you have this running you can connect to the VPN. The reason you need this VPN is to get access to the articles database which is being hosted from a server on FIU. If you are at FIU when running the program, you do not need to sign into the VPN because you're already on the same network.

The 2nd terminal will be used to run the MongoDB server. Run the following commands:

MacOS

If you installed MongoDB through HomeBrew (recommended) then you can simply start and stop MongoDB with the following commands, respectively.

```
$ brew services start mongodb  
$ brew services stop mongodb
```

Windows 10

```
$ "C:\Program Files\MongoDB\Server\4.0\bin\mongod.exe"  
--dbpath="c:\data\db"
```

At this point you want to open up MongoDB Compass. Leave the default settings and click Connect. You should now see on the terminal "connection accepted from..."

With the 3rd terminal, navigate to the user_database_server and run the following command:

MacOS

```
$ node server.js
```

Windows 10

```
$ nodemon server.js
```

You should see "Server started on port: 3000" and "Mongodb connection succeeded". Now you are free to use EnvoScholar v2.0.

6.4.3 Shortcomings/Wishlist Document

1. Add Markups: Functionality for users to add markups to their queries so that they can put multiple concepts together for a more detailed search.
2. Popular Concepts: Functionality for users to see popular concepts so that they can see what concepts are frequently searched to assist in the query construction.
3. Expand Search Filter: Functionality of a filter for the ontology page search so that users can search through concepts, descriptions, and relations.
4. Threading in Filter: Functionality to thread the filter to reduce the lag when using the search once the aforementioned filter is implemented.
5. Feedback Indexing: Functionality for users to rank the articles based on a global feedback value.

7 REFERENCES

1. Documentation for Angular 6: <https://angular.io/docs>
2. Documentation for NodeJS: <https://nodejs.org/en/docs/>
3. Documentation for MongoDB:
https://docs.mongodb.com/manual/?_ga=2.127843661.1176652703.1543341633-893410526.1541264451
4. Guide for MongoDB on Windows 10:
<https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/>
5. Youtube videos that were used to set up the MongoDB and user registration/login:
 - MEAN Stack User Registration Using Node JS - Part 1:
<https://www.youtube.com/watch?v=m34FCkBd7UU&t=1110s>
 - MEAN Stack User Registration Form With Angular 6 - Part 2:
<https://www.youtube.com/watch?v=V9zDNfVs7Z4>
 - MEAN Stack Jwt Authentication in Node JS API - Part 1:
<https://www.youtube.com/watch?v=T8qepiTbJi4>
 - MEAN Stack Login and Logout in Angular 6 - Part 2:
<https://www.youtube.com/watch?v=r0QYP61bCCM&t=25s>