NEOSPACE TRACKER

Group: *creative_orginal_name*

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Software Architecture

The architecture of a software system serves as a blueprint for the system. It is critical that a team models their software architecture before developing the system itself, as it will outline the different components that need to be developed as well as how they are connected. Designing the software architecture also allows the team to evaluate their skills and abilities, hence enabling them to select a web stack best suited towards them. The vital decisions that are made during this phase pave the way for the scalability of the development process.

Software architecture can be modelled in a variety of ways. Our team based the software architecture diagram off the 'layered approach', illustrating the major layers/components in the system (for example backend, frontend, etc) and how they pass data between one another.

Data sources

An important part of the NEOSpace app is the raw data that is used to create a refined presentation of information that is presented to users. This raw data comes from several data sources, the information from these data sources is obtained by querying the sources (either through JavaScript or the flask server) with specific queries determined by user inputs.

Asteroids NeoWs
The NeoWs API provides access to NASA's database of near-Earth objects (NEOs). This database will be queried with a start and end date. All NEOs that were present within the given time range are returned with information on their size, speed and luminosity. This information will be used to create a visual representation of the NEOs, for example the size data will be used to scale each object within the site.

Astronomy Picture of the Day (APOD)
The APOD API takes in a query containing the current date, which will return the astronomy picture of the day and a description of this picture. This data is used to showcase the astronomy picture of the day in a secret part of our site.

SbDb Close Approach data
This API provides access to a database that contains detailed information on close approach data for NEOs. This API will be queried with the name and id of a near-Earth object and will return data such as object class and orbit id. This information will be displayed to the user if they click an object and want to find out more about it.

Mars rover photos
This API can be queried by Mars or Earth date and will return images from some of the Mars rovers (Curiosity, Opportunity and Spirit), and mission manifests for each rover. This information will be used to display images from each of the Mars rovers to users.

Google images
Google images will be used to obtain images of famous NEOs. These images will be used to show users what the most interesting NEOs look like along with info on them.

Overview of the System
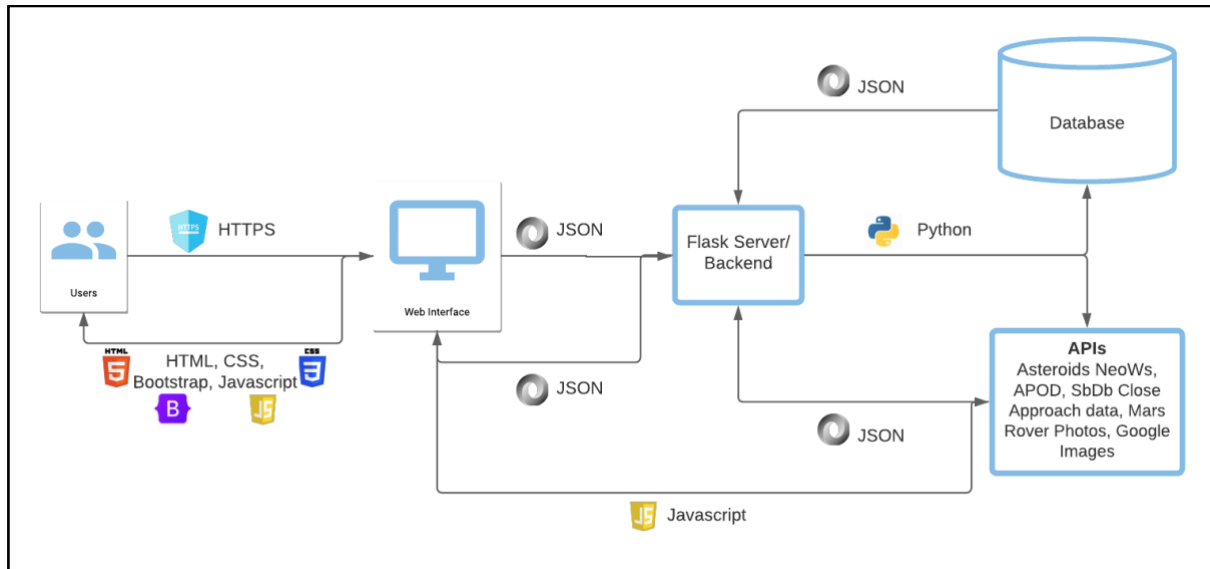
The above diagram describes the architecture of our software system. Our application will be in the form of a website, which users will access using HTTPS. In response, the site will display the home page which will be created using a combination of HTML, CSS, Bootstrap and JavaScript. As the user interacts with the site, JSON data with their queries will be sent to the flask server. This server will communicate to the APIs (described in detail above) using python and return relevant information as JSON. This JSON data is passed back to the website for the users and displayed in a more readable format using HTML. The interface will also be communicating directly with the APIs for some queries, using JavaScript. Specific interactions of the user and the interface will also lead to relevant data being passed to the flask to be stored in the database, so it is saved for each time the user visits the site.

Interface Layer: The interface layer comprises of the web interface, which users will interact with to navigate the site. The interface will display data and elements in a user-friendly way using a combination of HTML, CSS, and Bootstrap. Some pages are also very interactive, for example the NEOs page, hence JavaScript will also be used. The interface will also directly interact with the APIs by passing user's queries through JavaScript.

Server Layer: The system will use a flask server, which will be implemented in python. The server will communicate between the backend and frontend, passing the user's queries on to the APIs, as well as storing their data in the database. Within the backend, the flask will use python to interact with APIs and database, and pass data as JSON.

Backend Layer: The backend will be implemented in Python. This makes implementing the flask server much simpler and is a language the team is familiar with.

API Layer: The APIs being used and the justifications for why they are used is explained above (the data sources section). The APIs will answer users' queries and pass the required JSON data to the server or in some cases the interface.

Database Layer: The database will store the users' information (such as high score from game), as well as their messages from the chatbot. Such data will be stored along with the user's IP address, thus if users use the site again on the same device, progress will be saved.

Relating Choices/Justifications to components

Python: Python will be used to implement the backend. It was chosen because all group members have had experience with flask servers in python. Python's simple syntax also allows for fast and easy maintenance on the server if needed. Python also has a plethora of built-in scientific data libraries for handling the exact type of data used in this project.

Bootstrap: Bootstrap was chosen to assist the team with the creation of the interface as our team hasn't had much experience with HTML and CSS.

JavaScript: The use of JavaScript is necessary for some elements of our site, for example the interactive game and the NEO page. These are highly interactive and dynamic pages, hence the use of JavaScript will make coding these sections of the project much simpler.

JSON: The main data type used will be JSON, due to API providing data in this format. JSON is also easy to understand and works very well with Python. This makes it ideal for this project.

Platforms

With the rapid influx of development in web services, platform synchronisation is becoming the increasing standard. Meaning multiple platforms can coexist to create the finial system, as both Microsoft and Linux environments can be utilised.

Our server will be a flask server, which we would deploy on Linux (for simplicity), however the server could be deployed on windows or mac as well.

The webapp will be designed for specifically google chrome, however the site will also be useable on other browsers. Though, some features may not be supported such as the game which might not function on older browsers.

Initial Software Design

The 'Filter' feature

Description: On the "Near Earth Objects Page" there will be an optional menu bar to the left which when selected reveals a side panel. This side panel allows users to search near-Earth Objects (NEOs) for a particular criterion (e.g. time, name, size, type).

Feature: Apply a filter that allows users to search a particular NEO by time.

    As someone who is interested in space,

    I want to be able to see a list of NEOs when entering a specific range of time,

    So that I can view past NEO objects.

Scenario: View a list of NEOs when inputting a date/time range

    Given I am on the "Near Earth Objects" page

    When I press on the left panel in the NEO page

    Then a search bar should pop up which allows you to select the hour, day, month, year in a minimum and maximum range.

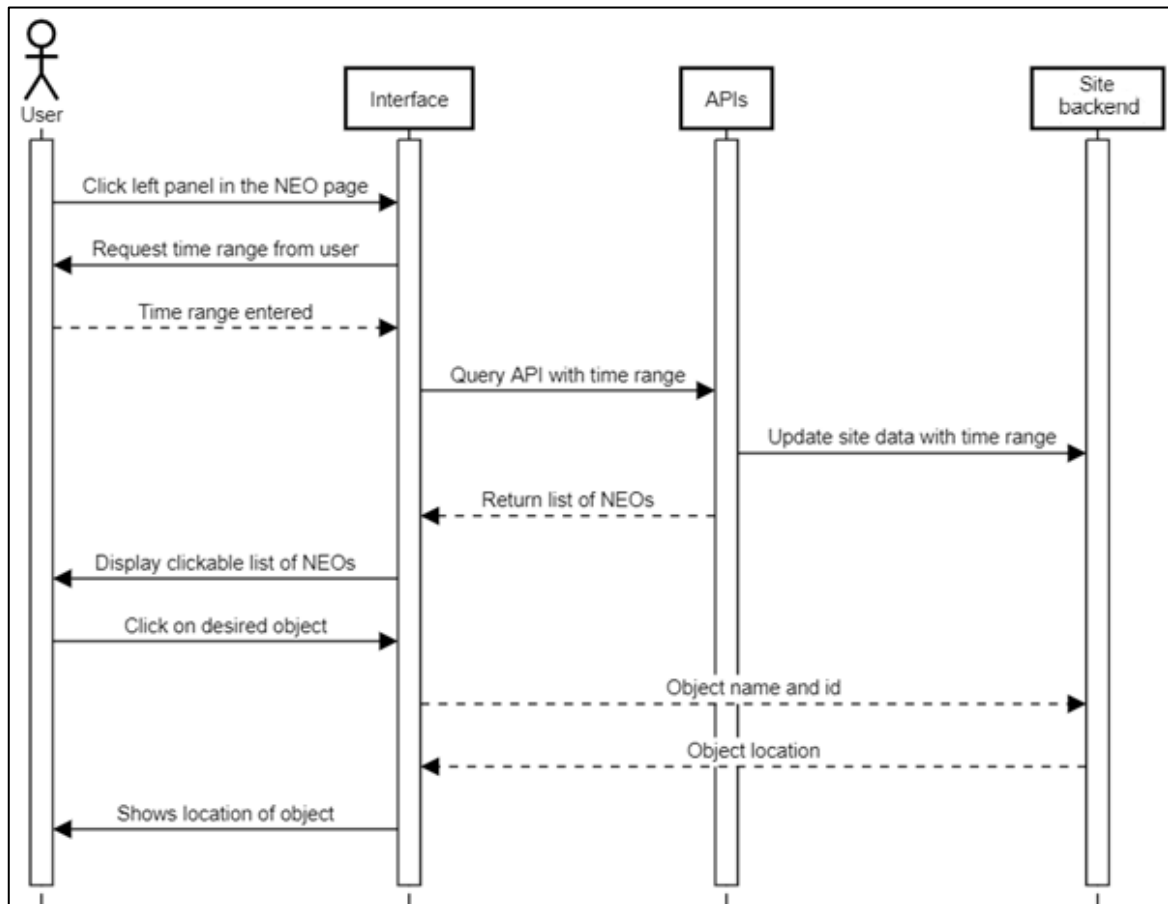   **When** I specify the input range for time

    And I enter the input range

    Then a list of clickable NEOs within those times/dates should appear.

    When I click on one of the search results,

    Then I should see the desired object's location relative to earth.

Sequence Diagram for the "Search NEO by time"

Feature: Search for a particular near-Earth object (NEO) by name.

As someone who is interested in physics and space,

I want to search for a particular near-earth object by name,

So that I can see a visual representation of this object.

Scenario: Search for a particular near-earth object by name

Given I am on the "Near Earth Objects" page,

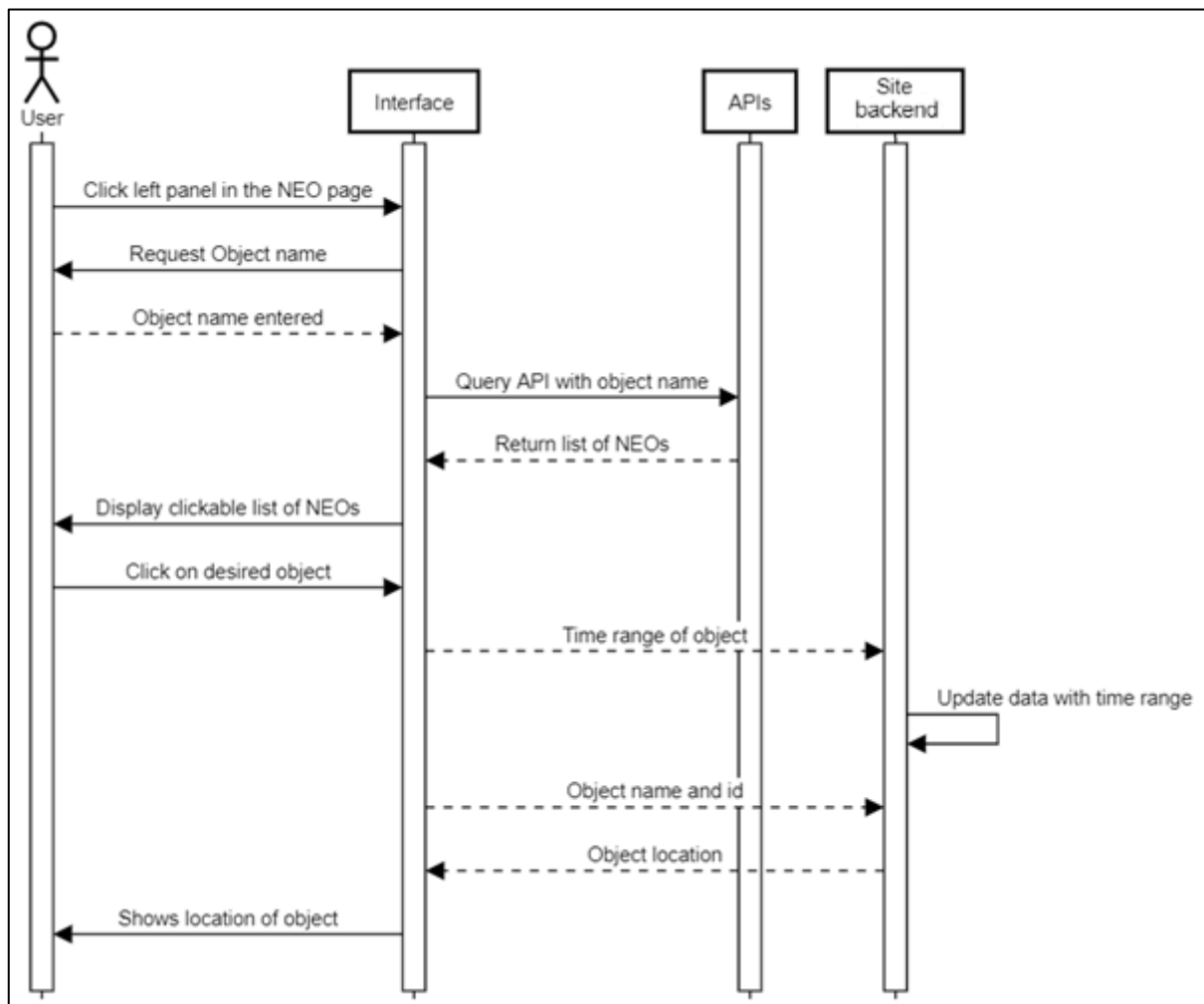**When** I press on the left panel,

Then a search bar should pop up.

When I type in the name of a particular object in the search bar,

Then a drop-down list of search results will appear.

When I click on one of the search results,

Then I should see the desired object's location relative to earth.

Feature: Filter the search results of near-Earth objects (NEOs) based on their brightness. With the basis of unit of measurement being absolute magnitude.

As someone who is interested in the brightness of objects in space,

I want to view a particular subset of NEOs based on their absolute magnitude,

So that I can see whether they are bright or dim.

Scenario: Filter particular NEOs with x units of absolute magnitude

Given I am on the "Near Earth Object" page,
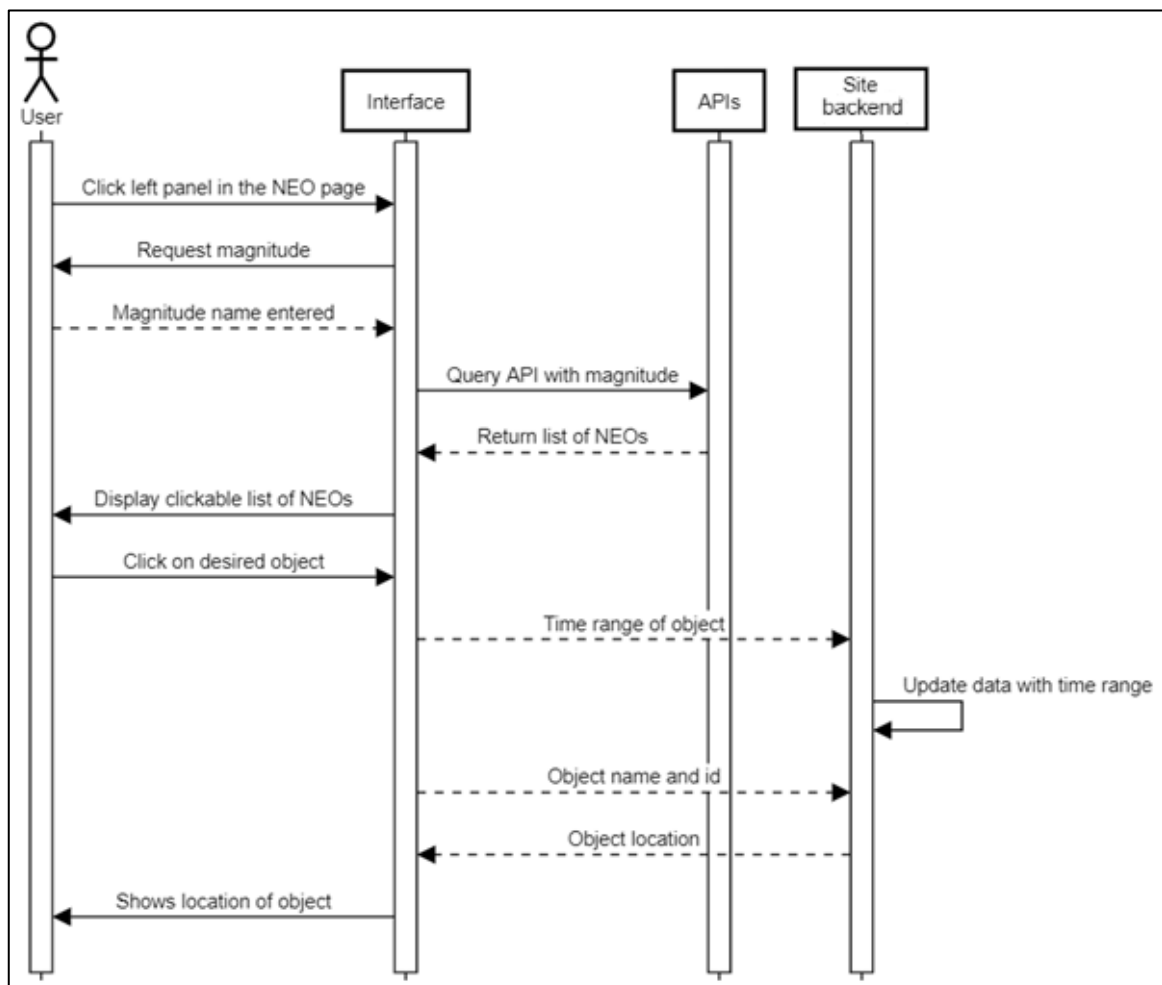
When I click on the left panel,

Then a search bar should appear to the left under the absolute magnitude heading.

When I specify the input number 'x' into the search bar,

Then a list of clickable NEOs with approximately x magnitude will be available.

When I click on one of the search results,

Then I should see the desired object's location relative to earth.

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Feature: Filter search based on classification of near-Earth Objects (NEOs).

As someone who is interested in space and time,

I want to be able to search on the type of NEO (asteroids, comets or meteoroids),

So that I can see a particular type of NEO.

Scenario: Search on the type of NEO.

Given I am on the "Near Earth Objects" page,
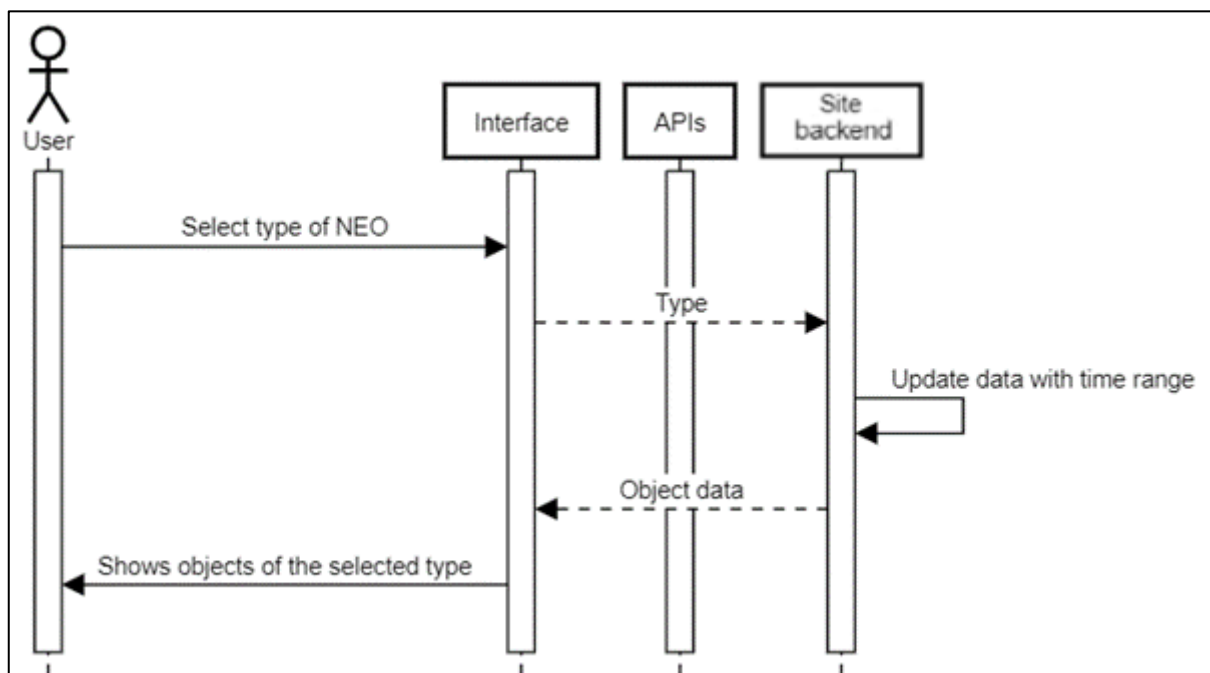
When I click on the left panel,

Then an additional filter bar should pop up to the left.

When I select "type",

Then a checklist should pop up with the types,

And when I select which type of NEO I want to view (asteroids, comets or meteoroids),

Then I should be able to view this particular subset of NEO on the page.

Information on Near-Earth Objects

Description: Provided users are on the "Near Earth Objects" page, selecting a near-earth object (NEO), will result in a panel appearing on the right side. This panel will contain a list of information on that NEO such as size, velocity, and distance. Users will also have the option at the top of the page to select a timeline slider where they can view recent NEOs up to a selected date.

Feature: View NEOs within a given range from current date to recent date.

> **As** someone who is interested in space
>
> **I want to** view the most recent NEOs by an interactive slider,
>
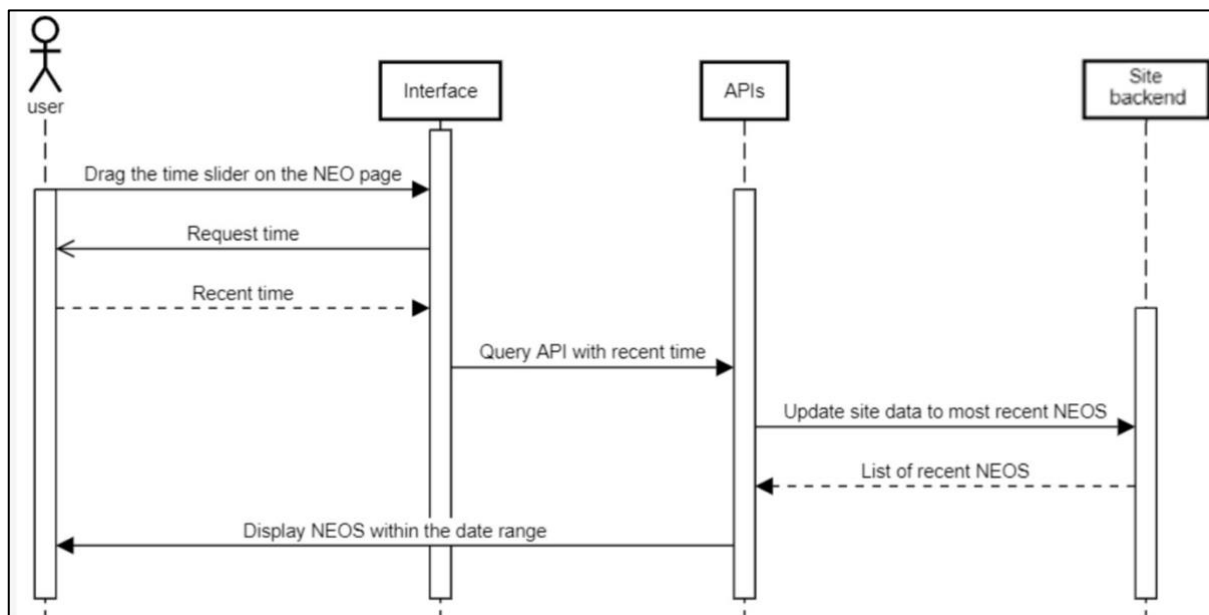> **So that I** can view NEOs within a given time range.

Scenario: View NEOs within a certain time range.

> **Given** I am on the "Near Earth Objects" page,
>
> **When** I drag the time slider bar which is to the top right,
>
> **And** I specify the time,
>
> **Then** all NEOs within that date will be displayed.

Feature: Calculate the size of Near-Earth Objects (NEO) in relation to object's which exist on Earth {a certain unit e.g., football fields}.

> **As** someone who is interested in the size of NEO
>
> **I want** to be able to make a real-world analogy,
>
> **So that I** can visualise the size of the NEO.

Scenario: View how many {certain units e.g., football fields} can fit across the length of the extra-terrestrial object

> **Given** I am on the "Near Earth Objects" page and have selected an extra-terrestrial object,
>
> **When** I click on a field in the toolbar called size comparison,
>
> **Then** a drop-down menu will show up with a list of objects that can be used for measurement,
>
> **When** I select the chosen size comparison {e.g. football fields},
>
> **Then** a straight line appears with a numerical value of how many {a certain unit e.g. Football fields} fit across the NEO appear right above the line.
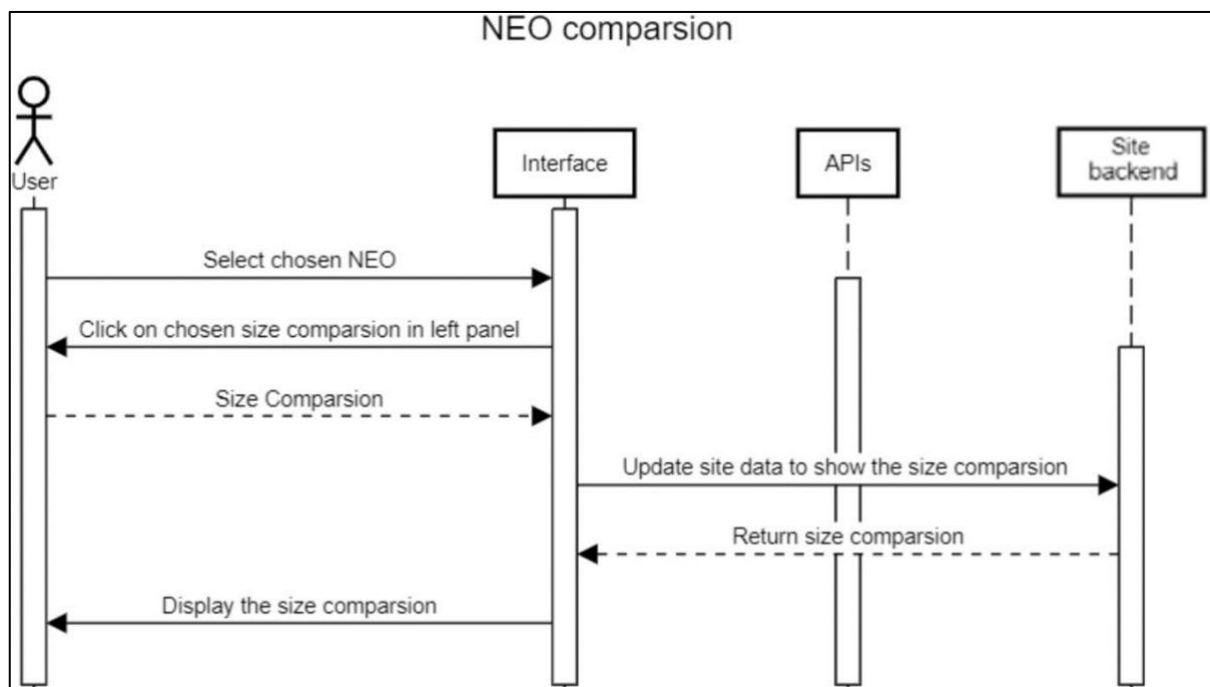
Feature: View information on a particular object such as its velocity, distance, speed orbit from Earth.

>**As** someone who is interested in physics and space,

>**I want** to view information on a particular near-Earth object (NEO),

>**So that I** can be given quantitative data on the NEO.

Scenario: View information on a particular near-earth object

>**Given** I am on the "Near Earth Objects" page,

>**When** I click on an object that I am interested in,

>**Then** a right-side bar should appear that displays information on a particular object such as its velocity, size and distance from earth.
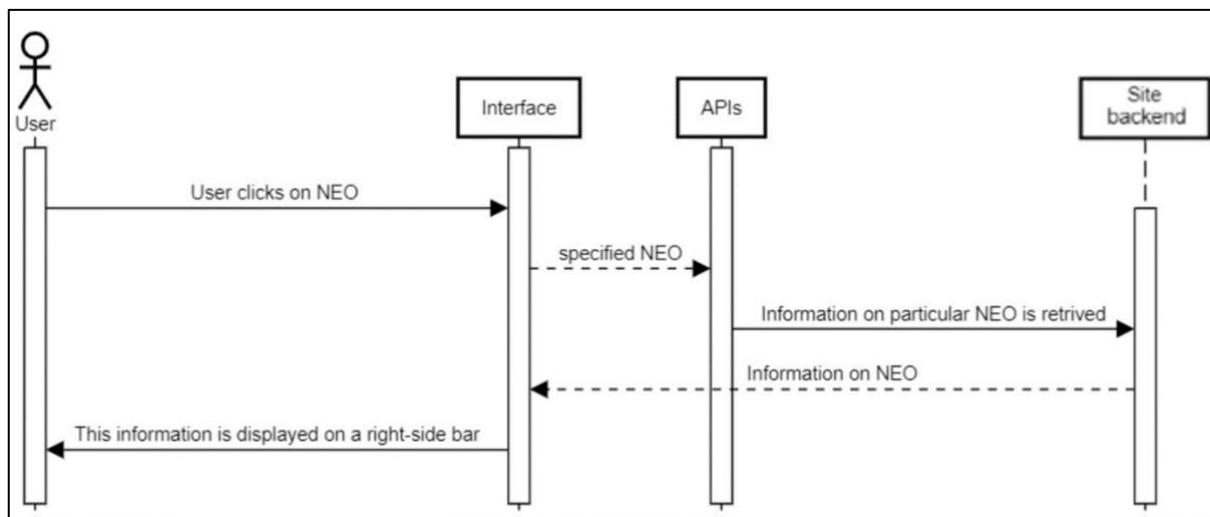
Picture of the Day

Description: A webpage which allows users to view the "Astronomy Picture of The Day"

Feature: View NASA's astronomy picture of the day

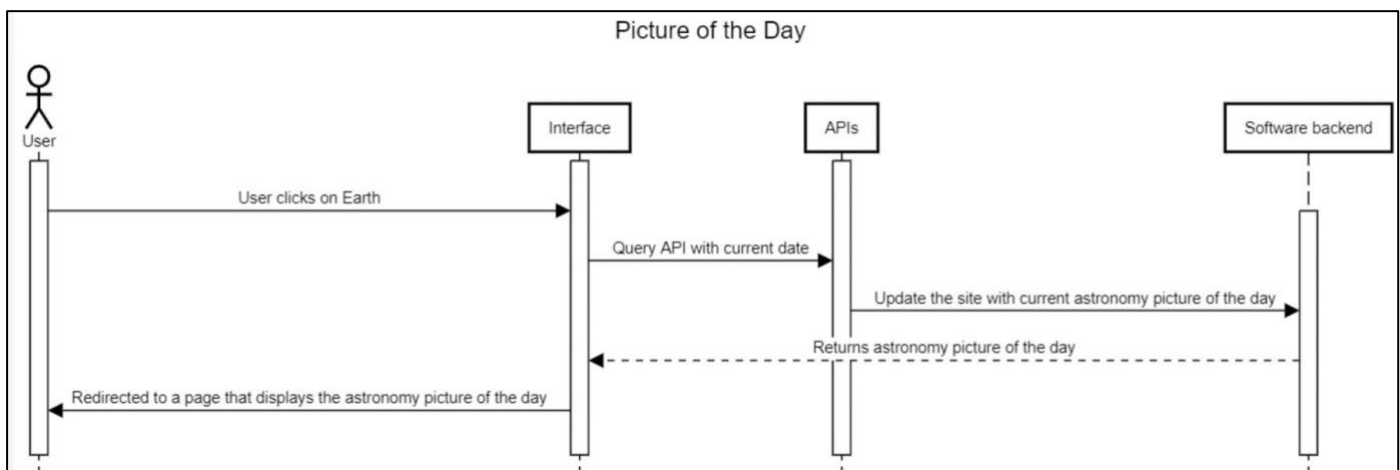> **As** someone who is interested in the beauty of space and astronomy,
>
> **I want to** easily be able to find the astronomy picture of the day.

Scenario: View the astronomy picture of the day

> **Given** I am on the "Main" page,
>
> **When** I click on the Earth,
>
> **Then** l am redirected to the "Picture of the Day" page which showcases the astronomy picture of the day with a description of the image.

Mars Rover Features

Description: Pages that allow users to view images and information/data related to those images.

Feature: View photos of Mars from a chosen Rover.

As someone who is interested in recent explorations of Mars,

I want to view a specific Rover,

So that l can view photos of Mars.

Scenario: View Mars Rover Photos
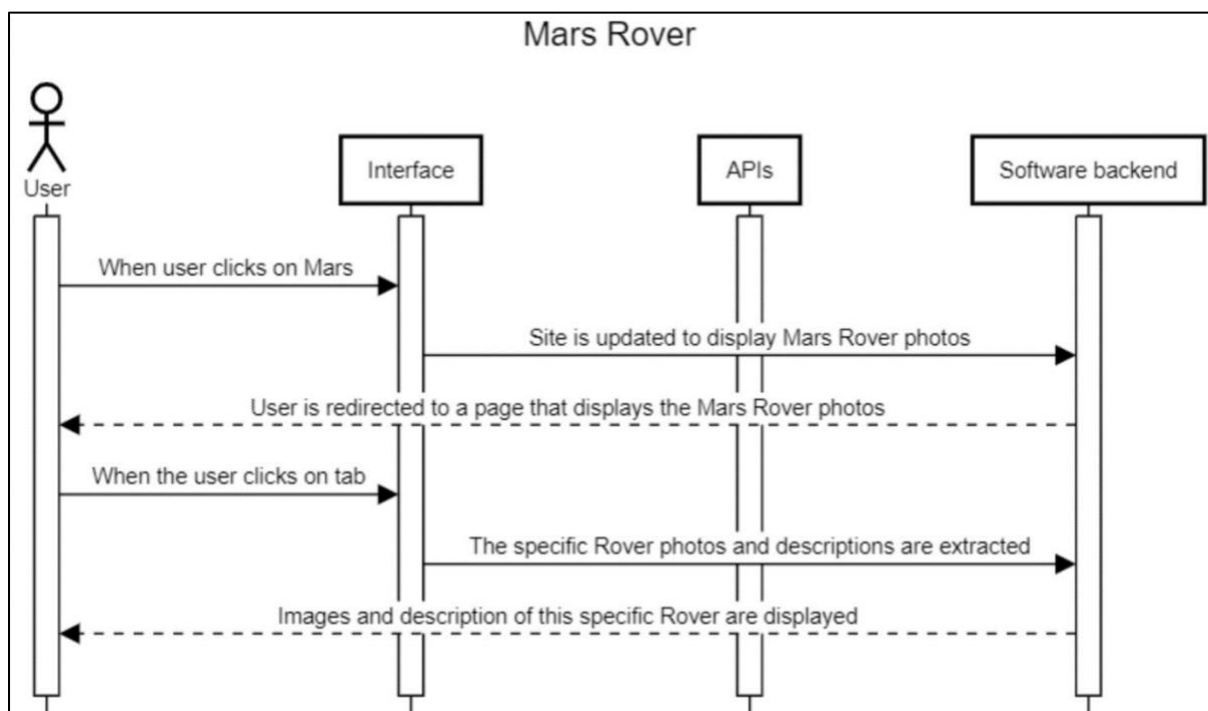
Given I am on the "Main" page,

When I click on Mars,

Then the "Mars Rover photos" page will be displayed,

And different tabs on top left with different Rover missions are showcased,

When I click on one of the tabs,

Then images and description of this Rover exploration will be displayed.

Global Chat

Description: A chat for the NEO page that allows all users currently on the page to talk to each other about anything to do with NEOs.

Feature: Read messages that have been sent by other users in the chat.

> **As** someone who is interested in discussing space and time,
>
> **I want to** be able to read messages that other users have typed,
>
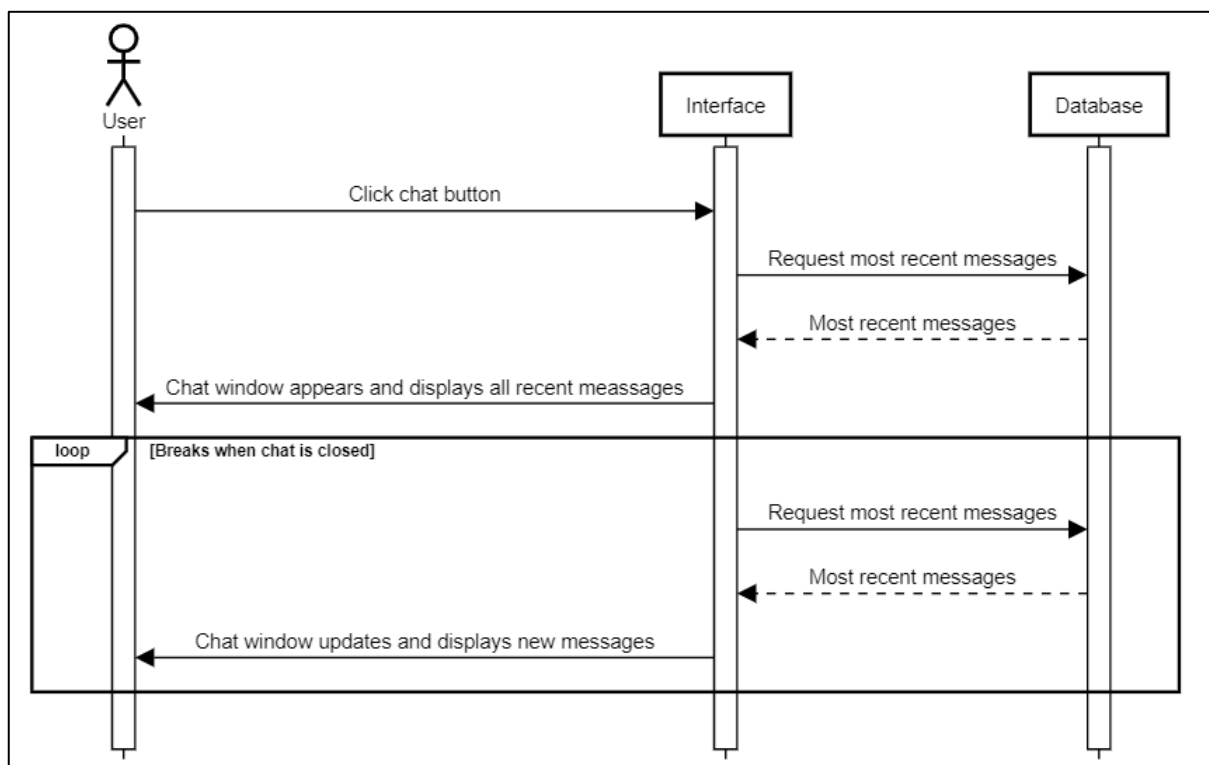> **So that I** can talk amongst others who are also interested in space and time.

Scenario: Read messages that users have sent in the global chat.

> **Given** I am on the "Near Earth Objects" page,
>
> **When** I click on the chat button at the bottom of the page
>
> **Then** a small chat window should appear at the bottom of the screen
>
> **And** I should see all recently sent messages from users of the site.

Feature: Send messages on the global chat for users on the NEO page

As someone who is interested in discussing space and time,

I want to be able to send messages to other users of the site,

So that I can talk amongst others who are also interested in space and time.

Scenario: Send a message in the global chat.

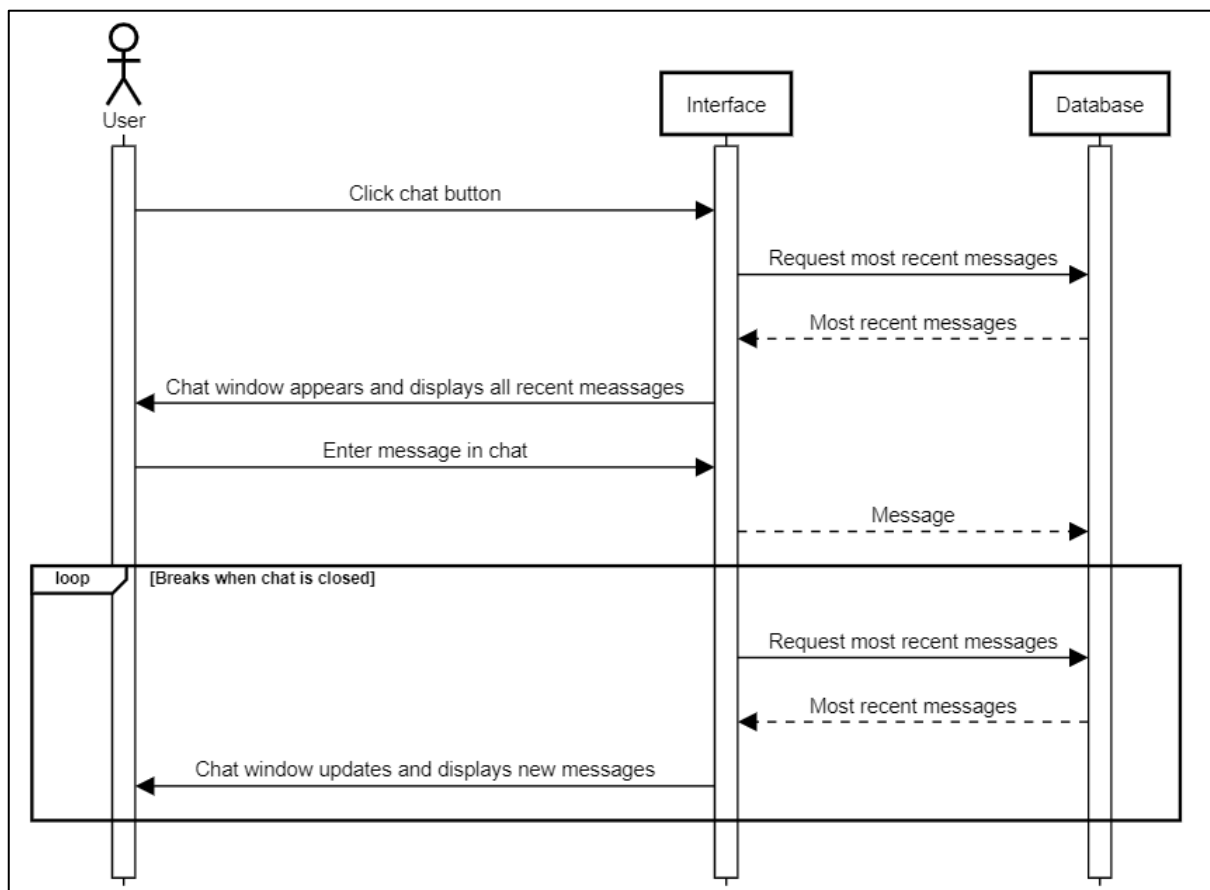**Given** I am on the "Near Earth Objects" page,

When I click on the chat button at the bottom of the page

Then a small chat window should appear at the bottom of the screen

When I enter a message in the chat

And I press the send button.

Then my message should appear in the global chat and be visible to other users.

Feature: Filter messages that have been sent by users in the chat.

As someone who is interested in discussing space and time,

I want to be able to read messages from a particular user,

So that I can read and understand what someone is saying easily

Scenario: Filter messages in the global chat by user

Given I am on the "Near Earth Objects" page,

When I click on the chat button at the bottom of the page
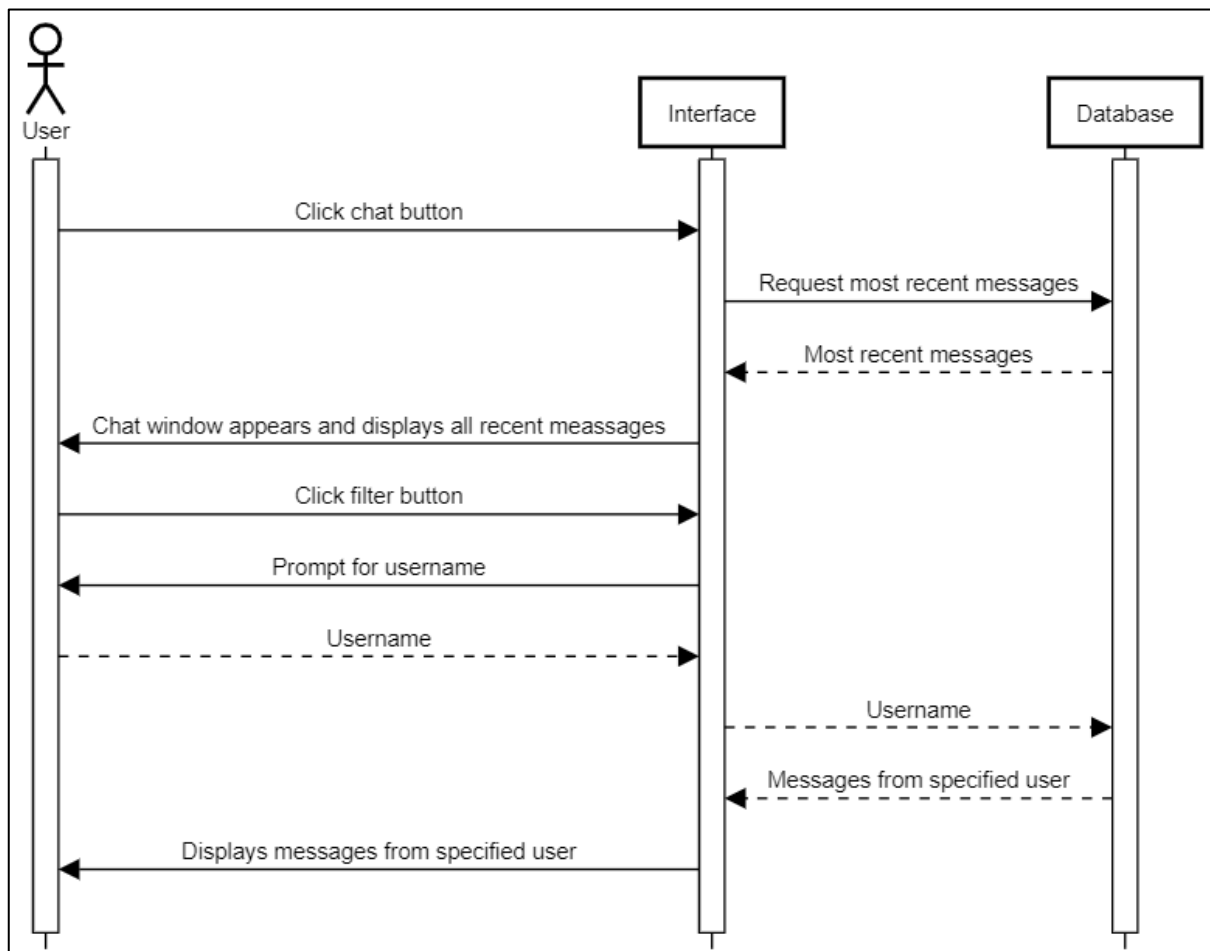
Then a small chat window should appear at the bottom of the screen

And I should see all recently sent messages from users of the site.

When I click the filter button

And I enter a user's name in the chat

Then I should see only messages sent by that user in the chat.

Educational Page

Description: A page for users who are interested in learning more about NEOs. This page will include and educational game and a few educational resources on the topic.

Feature: Play an educational game where you match an image and name of a NEO to its description.

> **As** someone who is interested in learning about NEOs,
>
> **I want to** be able to play a fun game that teaches me effectively,
>
> **So that I** can learn more about NEOs

Scenario: Play an educational game where you match an image and name of a NEO to its description.
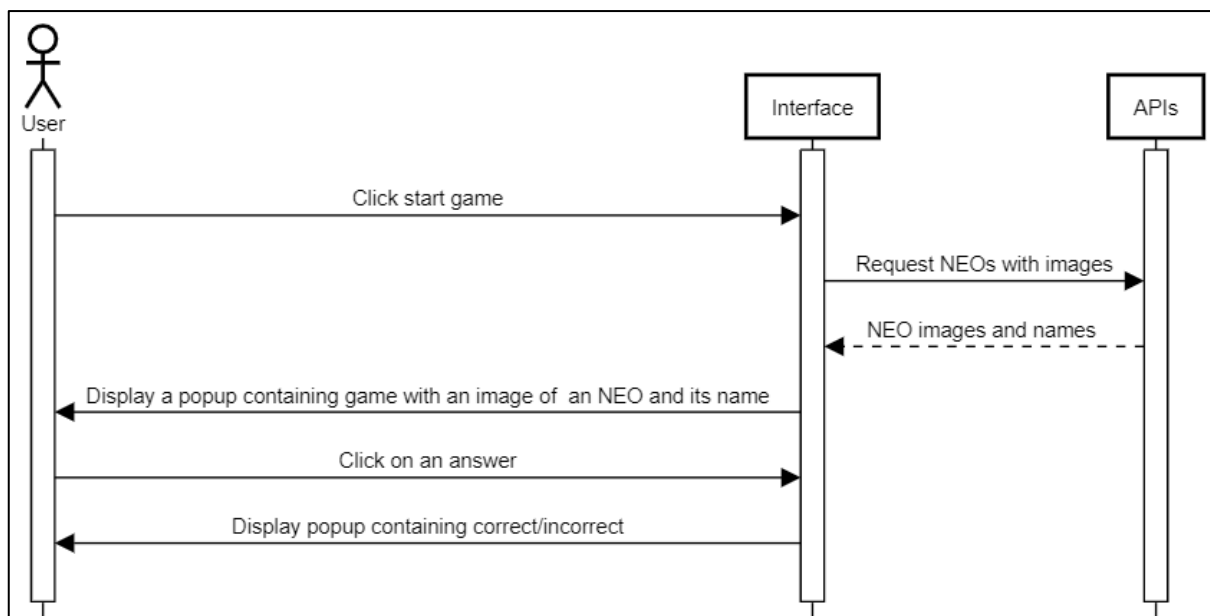
> **Given** I am on the "Learning" page,
>
> **When** I click on the start game button
>
> **Then** a popup containing the game should appear
>
> **And** I will see an image of an NEO and its name
>
> **When** I click on one of the four options for descriptions of this object
>
> **Then** I should see a message that tells me whether my choice was correct or not.

Feature: View the impact of high risk past NEOs

>**As** someone who is interested on the impact of NEOs

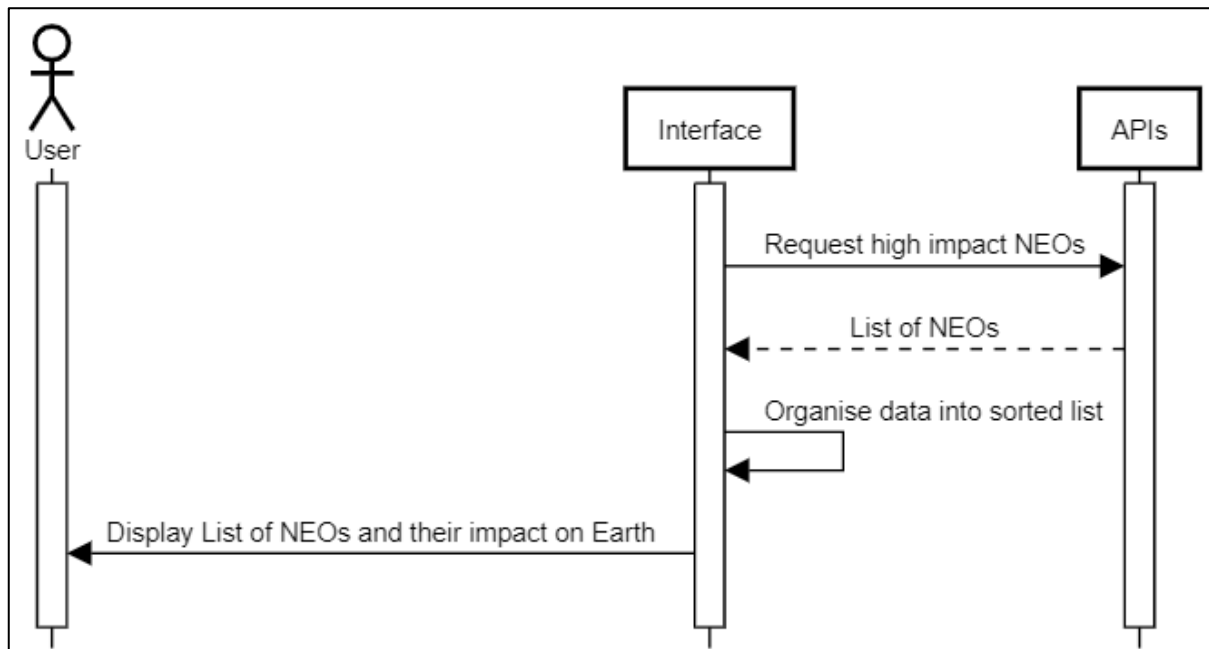>**I want to** be able to view the historical past NEOs,

>**So that I** can see the scale of impact they had on Earth.

Scenario: View a list of past NEOs and their impact

>**Given** I am on the "Learning page",

>**When** I scroll down to the "past NEOs section"

>**Then** I should see a list of NEOs from the earliest time increasing in time and the impact they have had on Earth.

Chat bot:

Description: Provide help to users with navigating the site.

Feature: Provide help to users with navigating the site.

As someone who is new to the NEOspace site,

I want to receive navigational help if I am stuck,

So that I can navigate the site easily.

Scenario: Getting navigational help from the chat bot
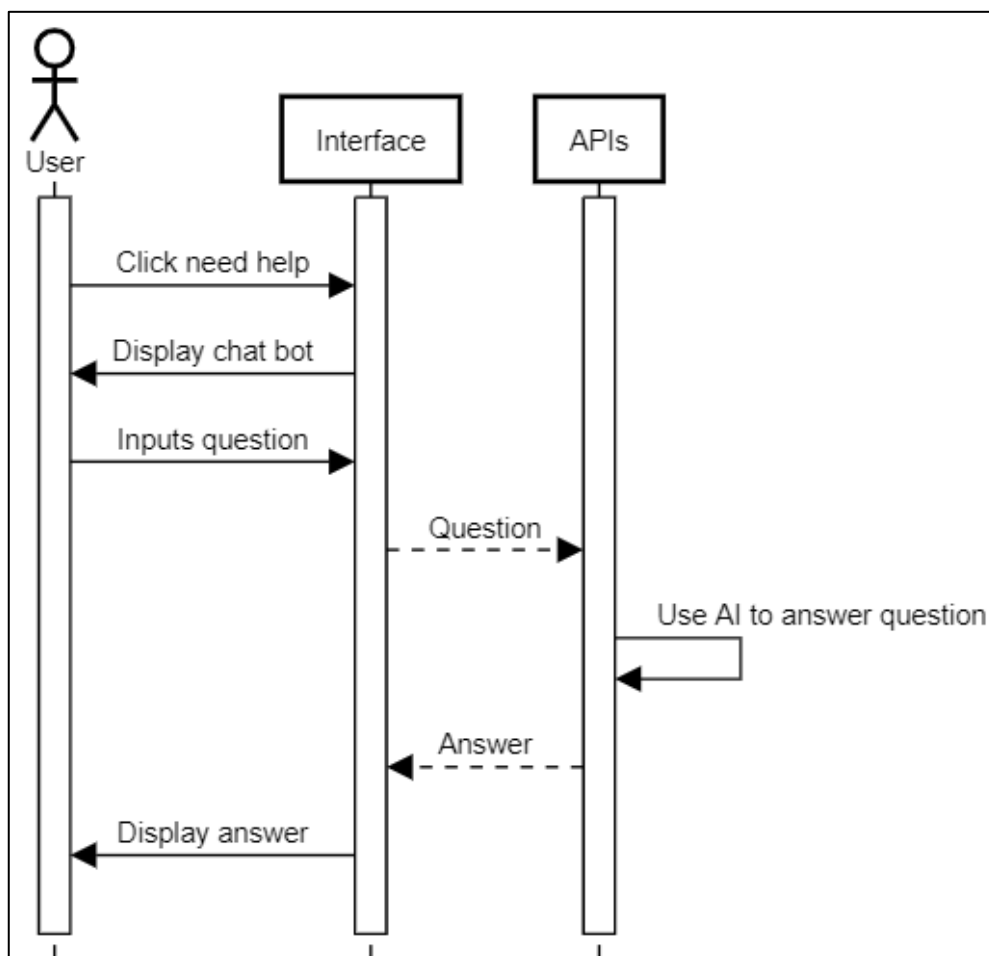
Given I am on any page on the NEOspace site,

When I click the "need help" button,

Then I should see a chat bot popup appear,

And It will ask me what the problem is,

When I explain my problem to the bot,

Then I should receive a solution to my problem.

Interactive Game

Description: A fun interactive game that users can play on the site. Starting from Earth users will navigate to a series of planets attempting to avoid orbiting near Earth Objects. It is based on an award system where points are awarded for distance (in kilometres) away from the Earth.

Feature: Play an interactive NEO game where users avoid NEO.

> **As** someone who is interested in Near Earth Objects,
>
> **I want to** be able to have an interactive game,
>
> **So that I can** remain engaged in learning the content.

Scenario: Play an interactive NEO game where users avoid NEO.

> **Given** I am on the "landing page",
>
> **When** I click on "Game" ,
>
> **Then** I should be redirected to "Game page", which displays Earth with a spaceship and a "Start button",
>
> **When** the user presses on one of the arrow keys or the "Start button",
>
> **Then** the game should start, where movement of the spacecraft will begin, incrementing the score of the user each second that passes,
>
> **When** the user is struck by a NEO
>
> **Then** the game should stop.
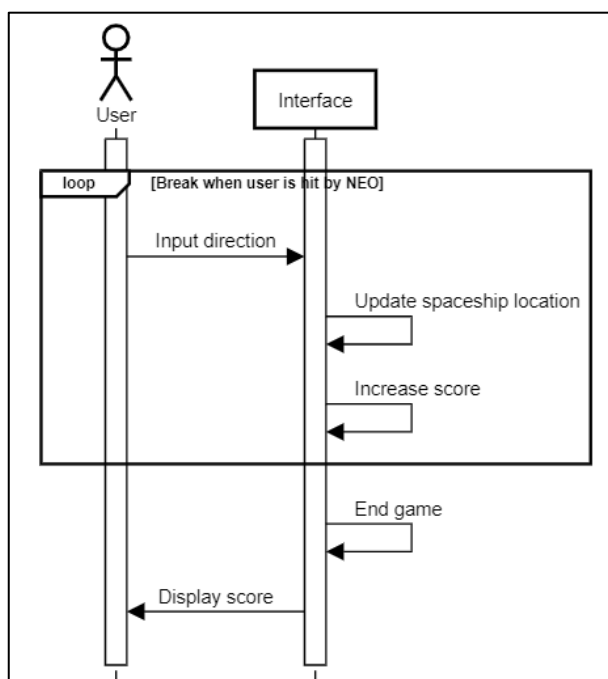
Feature: Pop-up questions users can answer.

>**As** someone who is interested in Near Earth Objects,

>**I want to** be able to answer quiz like questions,

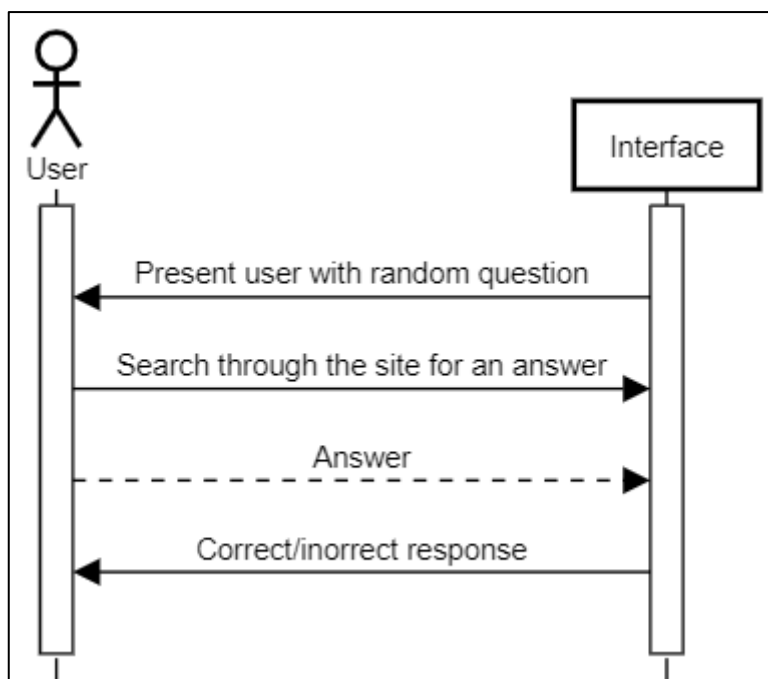>**So that I can** remain engaged and test my knowledge.

Scenario: Question pops up for user to answer.

>**Given** that I am on any page other than the "main" page,

>**When** I'm looking through the page, a question will pop-up at random,

>**Then** I will provide the prompt with an answer,

>**And** I will get a response stating that I was either correct or incorrect.

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