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РОЗШИРЕННЯ ФУНКЦІОНАЛЬНОСТІ NASA ЗА ДОПОМОГОЮ ЇЇ API ТА ПІДВИЩЕННЯ ЗАЦІКАВЛЕННЯ ЛЮДЕЙ У ДОСЛІДЖЕННІ КОСМОСУ

EXPANDING NASA FUNCTIONALITY USING ITS API AND IMPROVING INTEREST AMONG PEOPLE IN SPACE EXPLORATION

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Abstract. *This scientific work focuses on developing a website aimed at expanding the functionality of NASA's API and increasing public interest in space exploration. The project offers an interactive platform that allows users to engage more deeply with the Mars exploration mission. The website's primary features include storing photographs taken by Mars rovers, real-time monitoring of Martian weather conditions, access to NASA's "Picture of the Day," and displaying a 3D model of the Curiosity rover along with its current position.*

Users must register on the platform to access these features, enabling active engagement with the project. By leveraging NASA's API, the platform integrates up-to-date data, while modern approaches to routing, state management, and authentication ensure user convenience and security. A non-relational database is utilized for efficient information storage and accessibility.

The developed website not only enhances the functionality of NASA technologies but also creates a unique opportunity for a broad audience to feel part of the Mars exploration mission. This approach promotes space research, fosters interest in modern technologies, and motivates users to explore the universe.

Анотація *Дана наукова робота присвячена розробці вебсайту, спрямованого на розширення функціональності API NASA та підвищення інтересу до дослідження космосу. Проєкт створює інтерактивну платформу, яка дозволяє користувачам глибше долучитися до місії з дослідження Марсу. Основними функціями вебсайту є збереження фотографій, зроблених марсоходами, моніторинг погодних умов на Марсі в реальному часі, доступ до щоденних зображень NASA («Picture of the Day») та відображення 3D-моделі марсохода «Curiosity» разом із його поточною позицією.*

Користувачі проходять реєстрацію на платформі, що відкриває доступ до зазначених функцій та створює умови для активної взаємодії з проєктом. Застосування API NASA дозволяє інтегрувати актуальні дані, а використання сучасних підходів до маршрутизації, управління станом додатку та автентифікації забезпечує зручність та безпеку для користувачів. Нереляційна база даних використовується для ефективного зберігання інформації та забезпечення її доступності.

Розроблений вебсайт не лише розширює можливості використання технологій NASA, але й створює унікальну можливість для широкої аудиторії відчути себе частиною місії з дослідження Марсу. Такий підхід сприяє популяризації космічних досліджень, формує зацікавленість у сучасних технологіях та мотивує користувачів досліджувати Всесвіт.

Ключові слова: API, NASA, маршрутизація, управління станом, авторизація, автентифікація, нереляційна база даних.

Keywords: API, NASA, routing, state management, authorization, authentication, non-relational database.

1. INTRODUCTION

In the boundless expanse of space exploration, the National Aeronautics and Space Administration (NASA) stands at the forefront, unraveling the mysteries of the cosmos through pioneering space missions. As we delve into the realms of celestial bodies and interplanetary exploration, the integration of cutting-edge technologies becomes pivotal to disseminating the marvels of space to the global audience.

At the heart of this technological marvel lies the NASA API, a gateway to an unparalleled trove of information

gathered from various space missions. This API serves as a digital portal, granting access to a treasure trove of data, including awe-inspiring images captured by rovers on distant planets, real-time updates on weather conditions in outer space, and captivating insights into the latest discoveries across the space.

This presentation explores the fusion of NASA's API with the overarching theme of a Mars space mission website, designed to provide an immersive experience for space enthusiasts. As we navigate through the functionalities of this website, NASA API seamlessly weaves together real-time data, breathtaking imagery, and the spirit of exploration, culminating in a digital odyssey that invites users to embark on their own journey through the cosmos.

2. LITERATURE ANALYSIS

Before solving the problem, it is important to consider already existing applications that solve this or a similar problem (NASA [1]), after which – pay attention to the target tasks: Documentation for NASA API [2], Documentation for React [3], Documentation for React Router [4]. The works [5; 6; 7] describe algorithms and the selected programming language.

2.1 Analogues

The modern era of discoveries and technological achievements opens up new horizons for us to study the most distant objects in space. One of the defining steps in this direction was the Curiosity mission to Mars. In order to organize the received information and ensure reliable tracking of all aspects of the mission, there was a need for a highly effective Mars monitoring web application.

In fact, there are not many analogs with similar functionality on the Internet. However, the main NASA website provides some of the features described above and can be considered an analogue [1]. Since the site uses the NASA API [2], it is based on most of the data from the official NASA website.

The main addition to this site is a free storage of photographs taken by rovers on Mars.

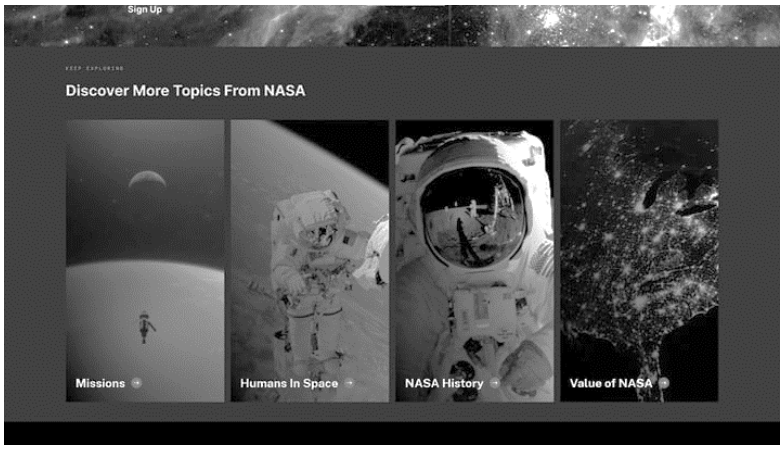

Fig. 1. NASA default website functionality

Fig. 2. Extended functionality of developed website

2.2 Tasks example

– Rover Photo Storage and Retrieval: Enable users to upload, store, and organize photos captured by Mars rovers. Provide a user-friendly interface for efficiently retrieving and viewing specific rover images.

– NASA Picture of the Day Access: Integrate with NASA's API to fetch and display the Picture of the Day, fostering a daily engagement with captivating cosmic imagery.

– Real-Time Weather Monitoring on Mars: Utilize Mars weather data to offer users up-to-date information on atmospheric conditions, temperature, and other relevant weather parameters.

– Curiosity Rover Model and Position Display: Implement a dynamic 3D model of the Curiosity rover, allowing users to explore its structure and components. Showcase the real-time position of the Curiosity rover on Mars, providing

an interactive experience for users to track its movements.

– Interactive Learning Opportunities: Facilitate educational initiatives by providing additional resources and information related to Mars exploration. Integrate interactive elements to engage users in learning about space missions, technology, and scientific discoveries.

– Cross-Platform Accessibility: Ensure the website is responsive and accessible across various devices, including desktops, tablets, and smartphones. Optimize user experience for both web and mobile platforms.

– Data Security and Integrity: Implement robust security measures to protect user data, especially considering the sensitive nature of personal accounts. Regularly audit and update security protocols to maintain data integrity and user trust.

By addressing these tasks, the Mars space mission website can offer a comprehensive and engaging platform for users interested in exploring and learning about the Red Planet and NASA's ongoing endeavors in space exploration.

2.3 Conclusion

The development of this project advances the Mars exploration mission by providing enhanced functionality for the NASA website and use of the NASA API. The project can be useful both for developmental purposes and for research.

3. OBJECT, SUBJECT, AND METHODS OF RESEARCH

The object of research is the process of monitoring information related to the mission of the Curiosity rover on the planet Mars.

Work topic: Development and implementation of a web application for monitoring the Curiosity mission on Mars.

The purpose of research is to develop and implement a web application that will provide users with information about the weather on Mars, current maps of Curiosity's location, as well as daily photos taken by the rover and saved by the current user.

The subject of research is the development and operation of a web application for monitoring the mission, which provides users with access to a variety of information, such as the weather on Mars, up-to-date maps of the location of the Curiosity rover, and daily photos. The subject of the study covers a specific aspect of the problem, namely the development and implementation of a web application for convenient and effective monitoring of the Mars mission.

This research aims not only to create a functional web application, but also to highlight the importance of monitoring the mission on Mars and further development in the field of space research.

3.1 Architecture

The project architecture answers various questions, starting with how the directory structure is built in the project, ending with how the business logic is separated from the user interface.

From the directory construction side, everything is primitive: to build an application, you need to conure all user access paths, which in turn are nothing more than individual pages, but pages can contain repeated interface elements, and therefore the structure can be broken down into components that will be reused when such a need. All main application paths will be contained in the top file App.tsx, which indicates all possible routes and user access paths (Fig 3).

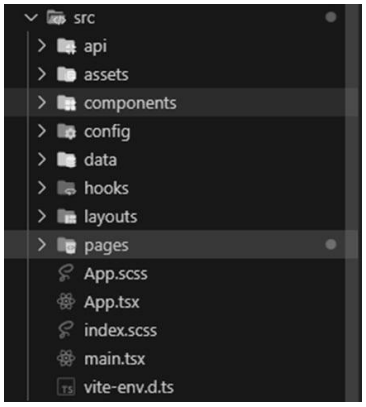

Fig. 3. An example of directory architecture

Still, the most important issue is the appropriate separation of business logic from the user interface. In this matter, the state management of the project helps to find a solution, because it processes internal requests to the state objects of entities, there are a bunch of libraries for using state management (Redux, Zustand, MobX), but considering the small number of entities in the project, it is worth using Zustand. as a simple entity model. Use of zustand:

```
import { create } from "zustand";
type UserPhotosSlice = {
//Type or interface of business logic access methods
//Entity type or interface};

const useUserPhotosSlice = create<UserPhotosSlice>((set) => (
{
```

```
//Essences of business logic
//Methods of addressing business logic

})
```

3.2 Routing and libs

To facilitate and optimize the development process, it is worth using the full potential of the framework [3, 4]. Unfortunately, React is not a framework, but only a library that needs additional libraries to reveal the potential of the application, so the following libraries are used in the project for their purpose:

- MUI (as the main UI library of the application)
- axios (use for requests to third-party resources)
- dayjs (date formatting)
- firebase (connecting the client with the server part)
- formik, yup (form processing and validation)
- framer-motion (animations and motion design)
- sass (css preprocessor)
- zustand (state management)
- react-router-dom (application routing)

Routing allows you to control the search of the user in react-router-dom, this is implemented through a provider that defines a certain number of routes (routes), which take the route and the page component of the request as attributes (routes can be nested, like components).

You can change the route using the useNavigate hook, the Navigate component, the usual links are replaced by the Link/NavLink component.

You can accept additional parameters or view a location object using useParams and useLocation, respectively.

Of course, React allows you to pass query parameters and use them, for example to search for the desired record among all. This is implemented through useSearchParams.

The react-router-dom library is a full-fledged extension of React functionality and is mandatory for the implementation of a SPA application on React.

3.3 Requests to external resources

It is convenient to use axios to access external resources, databases, and APIs. Axios is a library for making HTTP requests in web applications that works both browser-side and server-side. It allows you to easily interact with APIs and other resources, providing a convenient interface and capabilities for processing requests and responses. Axios supports promise, which facilitates asynchronous operations and allows efficient HTTP requests. To begin with, you need to set the initial url of the request:

	nel=https://nel.heroku.com/reports?ts=1701894709&sid=929419e7-33ea-4e2f-85f0-7d8b7cd5cbd6&s=ZVI%2FqfM0Lq4JcfDEPqEXIDsMi7df1JYxu0WruJJuHZI%3D
Strict-Transport-Security:	max-age=31536000; includeSubDomains; preload
Strict-Transport-Security:	max-age=63072000; includeSubDomains
Vary:	Origin
Via:	1.1 vegur, https/1.1 api-umbrella (ApacheTrafficServer [cMsNf])
X-Api-Umbrella-Request-Id:	cc83a5v3oefdimdcudog
X-Cache:	MISS
X-Content-Type-Options:	nosniff
X-Download-Options:	noopen
X-Frame-Options:	SAMEORIGIN
X-Permitted-Cross-Domain-Policies:	none
X-Ratelimit-Limit:	2000
X-Ratelimit-Remaining:	1996
X-Request-Id:	56c9872c-139c-4720-ae1c-778b47a2d34c
X-Runtime:	0.269116
X-Vcap-Request-Id:	d9cede20-57db-443b-7443-a4cef9e66408
X-Xss-Protection:	1; mode=block

Fig. 4. An example of a response to an api call

```
const api = axios.create({
baseURL: "https://api.nasa.gov",
timeout: 5000,
});
```

Individual resources can be accessed through asynchronous methods:

```
const response = await api.get(
`/planetary/apod?api_key=${import.meta.env.VITE_API_KEY}`);
```

4. RESULTS

The main page (Fig. 5) contains links to services and user authentication, the user can use the services only under the condition of authorization, therefore, if this condition is violated, the user will be redirected to the authorization page (Fig. 6).

The main page, in turn, uses many elements of motion design to capture the user. An additional scroll appears on top, paragraphs float on different sides of the page, a shadow is placed on the footer and header.

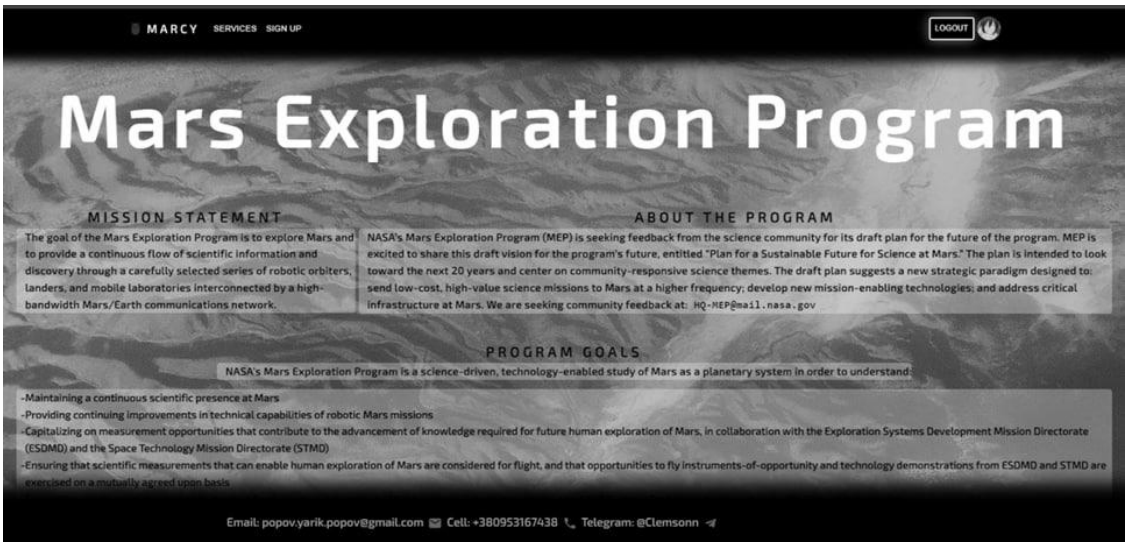

Fig. 5. Landing

Fig. 6 Registration page

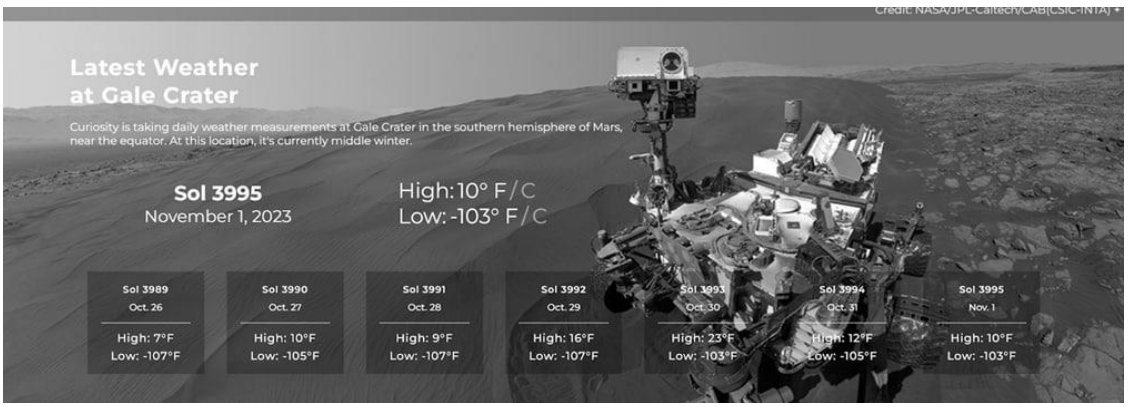

Fig. 7. Weather service

Fig. 8. APOD (astro pic. of the day) service

Fig. 9. Rover3D service

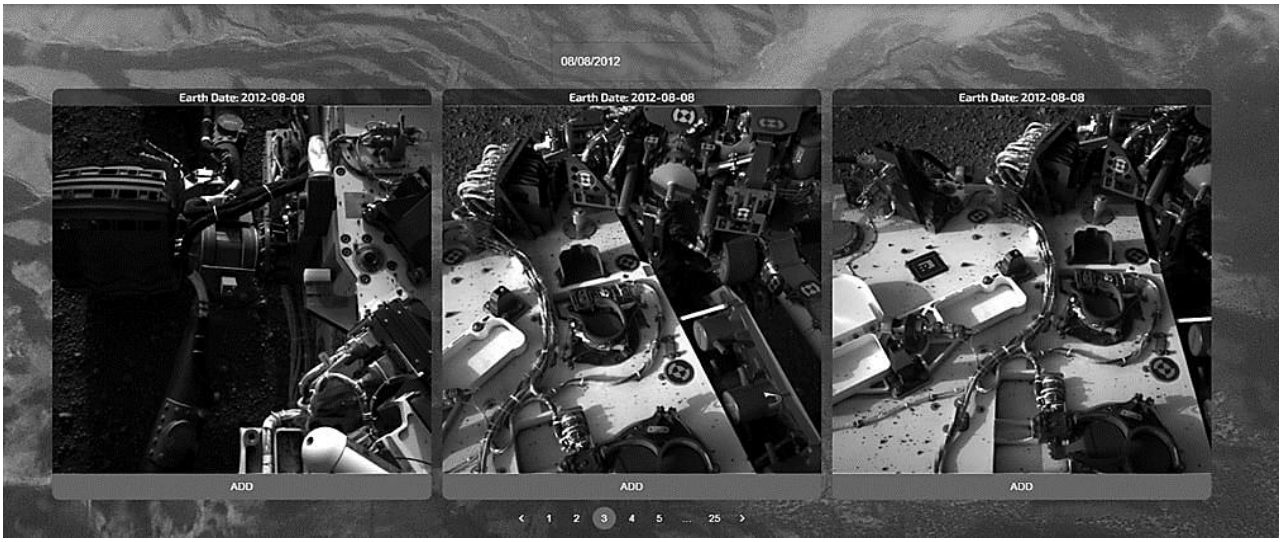

Fig. 10. Photos monitoring service

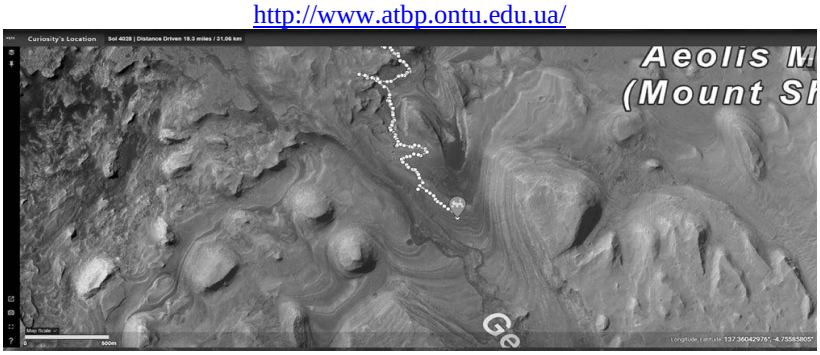

Fig. 11. Surface monitoring service

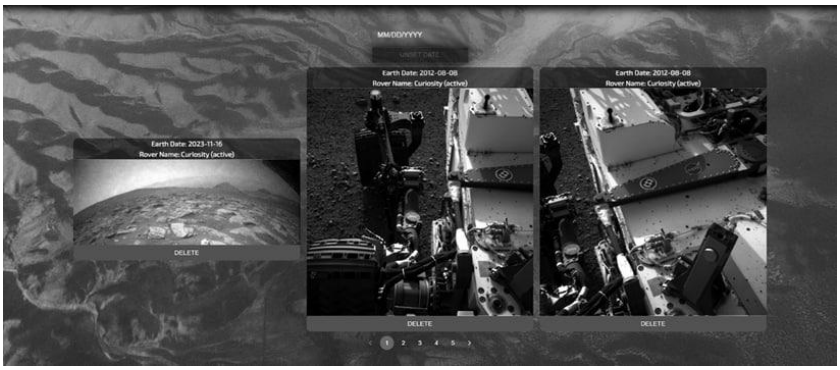

Fig. 12. Photo storing service

5. CONCLUSIONS

According to the work performed, the development of an application for monitoring Mars is an important and urgent task that has a significant impact on our understanding of the red planet and the development of space exploration in general. Therefore, the importance of such an application can be emphasized in the context of the following aspects:

1. Scientific Contribution: The Mars Monitoring App allows scientists and astronomers to access critical data, such as photographs, climate parameters, and other measurements, that are necessary to further explore Mars and unlock its mysteries.
2. Space mission support: The application can be an important tool to support real space missions to Mars, where it can serve to obtain and analyze data necessary for successful mission execution and interaction with space equipment.
3. Educational function: the application can be a powerful tool for education and popularization of space sciences. It allows a wide audience, including students, researchers and simply interested individuals, to access important information about Mars and space.
4. Spreading interest in space: The application can play an important role in creating and maintaining public interest in space and planetary exploration. It creates an opportunity for the general public to get a unique view of Mars and the events that take place on it.

The project is deployed and available for use. The general application can be viewed at the following link: https://marcy-33849.web.app/.

REFERENCES

1. NASA. Retrieved December 3, 2023, from https://www.nasa.gov/
2. Documentation for NASA API. Retrieved December 15, 2023, URL: https://api.nasa.gov/
3. Documentation for React. Retrieved December 3, 2023, URL: https://ru.legacy.reactjs.org/docs/getting-started.html
4. Documentation for React Router. Retrieved December 13, 2023, URL: https://reactrouter.com/en/main
5. Aditya Bhargava Groking Algorithms, An Illustrated Guide for Programmers and Interested 2021, 288 p.
6. Robert Martin Clean Code, Creation, Analysis and Refactoring, 2008, 464 p.

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

1. NASA. Використано 3 грудня 2023 року з https://www.nasa.gov/
2. Документація до NASA API. Використано 15 грудня 2023 року, URL: https://api.nasa.gov/
3. Документація до React. Використано 3 грудня 2023 року, URL: https://ru.legacy.reactjs.org/docs/getting-started.html
4. Документація до React Router. Використано 13 грудня 2023 року, URL: https://reactrouter.com/en/main
5. Адітя Бхаргава. Вивчення алгоритмів: Ілюстрований посібник для програмістів та зацікавлених осіб. 2021 рік, 288 стор. Роберт Мартін.
6. Чистий код: створення, аналіз і рефакторинг. 2008 рік, 464 стор.