

## **1. Project Summary:**

We are a multidisciplinary, international team based in North Macedonia, composed of experts in engineering, design, data science, molecular biology and medicine. Together, we share a unified mission: to pioneer the development of sustainable, efficient, and adaptable human habitats capable of supporting life beyond Earth. Our work is guided by the belief that humanity's future in space will be defined not only by our ability to explore, but by our capacity to build, live, and thrive in new worlds.

As we enter a new era of extended missions to the Moon, Mars, and beyond, the creation of functional, resilient, and human-centered habitats stands as one of the most critical challenges in space exploration. These challenges span multiple dimensions:

- **Resource Scarcity:** Ensuring closed-loop systems that efficiently manage limited supplies of energy, water, and oxygen.
- **Spatial Constraints:** Designing within strict launch and transportation limits while maximizing livability and operational functionality.
- **Environmental Hazards:** Protecting inhabitants from cosmic radiation, microgravity effects, and extreme planetary conditions.
- **Human Factors:** Supporting physical health, psychological well-being, and ergonomic performance in prolonged, confined environments.

Despite advances in simulation and design tools, current habitat design processes remain static, complex, and resource-intensive, often relying on specialized software and limited to small expert teams. This restricts rapid iteration and excludes broader collaboration from scientists, educators, and innovators who could contribute valuable insights.

Our central challenge is to create an accessible, interactive, and scientifically accurate platform that empowers users to design, visualize, and evaluate space habitats with both creativity and precision. By integrating data-driven modeling, intuitive interfaces, and open-access design tools, we aim to democratize space habitat design—bridging the gap between professional research and public imagination.

Through this initiative, we aspire to bring a solution and to support NASA's broader vision of sustainable lunar and Martian presence, fostering innovation that extends beyond Earth and brings humanity closer to becoming a multiplanetary civilization.

## **2. Project Demonstration:**

Imagine designing your very own home in space—this is exactly what the Habitat Layout Creator makes possible. This web-based platform empowers a diverse range of users—from curious students and educators to experienced researchers and engineers—to create, visualize, and refine space habitats within simulated extraterrestrial environments. It is more than a tool; it is a bridge between imagination and scientific reality, turning the dream of living in space into an interactive, hands-on experience.

The platform's capabilities are designed to make space habitat design intuitive, immersive, and collaborative:

- **Modular, Drag-and-Drop Design:** Users can construct habitats piece by piece using components such as sleeping pods, life support systems, and research modules, tailoring layouts effortlessly to meet mission objectives.
- **3D Environmental Simulation:** Designs can be tested under realistic conditions, including low gravity, radiation exposure, and lighting variations, ensuring the habitat responds accurately to the extraterrestrial environment.
- **Optimization Engine:** AI-driven suggestions help improve energy efficiency, spatial utilization, and crew comfort, enabling practical, high-performance habitat configurations.
- **Human-Centric Design:** Ergonomic and psychological considerations are integrated into the design process, ensuring habitats are not only functional but also supportive of human well-being.
- **Collaborative Platform:** Users can share, iterate, and refine designs with team members or the broader open-source community, fostering innovation and collective problem-solving.
- **Educational Mode:** The platform features a user-friendly interface tailored for classrooms, workshops, and public engagement, making space architecture accessible to everyone.

By combining scientific rigor, advanced simulation, and intuitive design tools, the Habitat Layout Creator transforms complex habitat engineering into a creative, interactive, and

inclusive experience—enabling the next generation of explorers, researchers, and enthusiasts to envision and build humanity’s future homes beyond Earth.

### **3- Project :**

The Habitat Layout Creator introduces several key innovations that set it apart as a transformative tool for space habitat design:

- **Accessibility:** By democratizing the design process, the platform enables students, educators, and non-specialists to actively engage in creating scientifically grounded space habitats.
- **AI Integration:** An AI-driven optimization engine guides users to enhance layout efficiency, resource management, and human comfort, making complex design decisions more intuitive.
- **Educational Outreach:** Its user-friendly interface supports classroom learning, workshops, and public engagement, inspiring curiosity and hands-on learning in space science and engineering.
- **Scalability:** The platform is fully adaptable for lunar, Martian, or orbital habitats, providing a versatile framework for a wide range of mission scenarios.
- **Open-Source Collaboration:** By encouraging global collaboration and iterative development, the platform fosters innovation across disciplines and borders.

### **Potential Impact:**

The Habitat Layout Creator promises to make a meaningful contribution to both education and space exploration:

- **Inspiring Future Space Engineers:** By making habitat design accessible and interactive, it motivates the next generation of innovators and explorers.
- **Supporting NASA and Partners:** The platform provides a practical tool for conceptual design phases, accelerating iteration and improving mission planning.
- **Fostering Interdisciplinary Collaboration:** By bridging architecture, science, psychology, engineering, and data science, it promotes holistic, human-centered design approaches for space habitats.

## **4- Use of AI**

Through its combination of accessibility, AI-driven guidance, and collaborative features, the Habitat Layout Creator is poised to transform how we conceptualize, design, and learn about living in space, cultivating both practical solutions and the imagination needed for humanity's next steps beyond Earth.

Artificial Intelligence lies at the heart of the Habitat Layout Creator's innovation.

Our **AI optimization engine** enhances the design process by:

- **Recommending optimal module arrangements** for spatial efficiency.
- **Analyzing environmental variables** (radiation exposure, lighting, gravity effects) to suggest design improvements.
- **Balancing human comfort and performance**, using psychological and ergonomic models.
- **Learning from user data**, continuously refining recommendations for future layouts.

This AI-driven design assistant transforms the user experience—from trial-and-error to data-informed creativity—making professional-grade space design achievable for everyone.

## **5. NASA Data:**

Our work is built upon the foundation of **NASA's open data ecosystem**, ensuring scientific accuracy and realism. Key data sources include:

- **Lunar and Martian Habitat Environmental Datasets** – Atmospheric and terrain conditions.

- **International Space Station (ISS) Module Data** – Real-world reference for interior design and module integration.
- **NASA’s Environmental Control and Life Support Systems (ECLSS)** – For modeling air, water, and waste recycling.
- **Human Research Program (HRP)** – Data on human factors, circadian rhythms, and long-duration spaceflight psychology.

These datasets allow our tool to simulate credible extraterrestrial living conditions, providing users with a scientifically grounded design experience aligned with NASA’s standards and mission goals.

## **6. Space Agency Partners:**

The Habitat Layout Creator aligns closely with NASA’s ongoing efforts toward a sustainable human presence on the Moon and Mars, particularly under programs such as Artemis and the Lunar Gateway initiative.

The project also fosters potential collaboration opportunities with other space agencies and organizations working on habitat research, including:

- **European Space Agency (ESA)** – Human habitation research and simulation facilities.
- **Canadian Space Agency (CSA)** – Robotics and life-support integration.
- **Japan Aerospace Exploration Agency (JAXA)** – Habitat technology and resource utilization.

By providing an open, collaborative platform, *Your Home in Space* offers a bridge between educational communities, researchers, and global space agencies, encouraging shared progress toward sustainable life beyond Earth.

## Conclusion

*Your Home in Space – The Habitat Layout Creator* is more than a tool: it's a gateway to the future of human living beyond Earth. Through AI, open NASA data, and global collaboration, it empowers people everywhere to design, learn, and innovate for the next great leap in human exploration.

“Design your home in space — because humanity’s future is written among the stars.”

## Team Information

- **Team Name:** Polin Space Society
- **Base:** North Macedonia (International Team)
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