NASA SPACE HABITAT LAYOUT CREATOR - DETAILED REQUIREMENTS

TASK 1: COMPREHENSIVE REQUIREMENTS TABLE

FUNCTIONAL REQUIREMENTS

Req ID	Category	Requirement Name	Description	Priority	NASA Reference	Implementation Notes
FR-001	Core Functionality	Habitat Shape Selection	Allow users to select from multiple habitat geometries (cylindrical, spherical, inflatable, dome, modular)	CRITICAL	NASA habitat classification	Dropdown menu with 3D preview
FR-002	Core Functionality	Dimension Configuration	Enable users to define habitat dimensions (length, width, height, diameter, volume)	CRITICAL	Launch vehicle constraints	Input fields with real-time validation
FR-003	Core Functionality	Crew Size Configuration	Allow specification of crew size (1-20 crew members)	CRITICAL	Artemis mission specs	Slider + numeric input
FR-004	Core Functionality	Mission Duration Input	Enable mission duration setting (days/months/years)	CRITICAL	Mars mission planning	Time selector with presets
FR-005	Core Functionality	Destination Selection	Select mission destination (Moon, Mars Transit, Mars Surface, LEO)	HIGH	Artemis & Mars campaigns	Dropdown with environment data
FR-006	Layout Design	Drag-and-Drop Modules	Interactive drag-and-drop interface for placing functional modules	CRITICAL	User experience	HTML5 drag events
FR-007	Layout Design	Module Library	Comprehensive library of functional areas (life support, waste	CRITICAL	ISS module specs	10+ module types minimum

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			mgmt, crew quarters, etc.)			
FR-008	Layout Design	Module Resizing	Allow users to resize modules based on crew size and mission duration	HIGH	HIDH guidelines	Interactive handles
FR-009	Layout Design	Multi-Level Design	Support for multiple deck levels within habitat	MEDIUM	Multi-deck habitat concepts	Vertical stacking interface
FR-010	Layout Design	Radial Layout Option	Enable radial arrangement around central core	MEDIUM	Cylindrical habitat design	Polar coordinate system
FR-011	Validation	Volume Calculation	Real-time calculation of total habitat volume	CRITICAL	Geometric calculations	Mathematical formulas
FR-012	Validation	Space Utilization	Show percentage of used vs. available volume	CRITICAL	Mission planning	Progress bars/charts
FR-013	Validation	Constraint Checking	Validate that functional areas meet minimum size requirements	CRITICAL	NASA HIDH standards	Rule engine
FR-014	Validation	Visual Feedback	Color-coded feedback (green/yellow/red) for design compliance	HIGH	User guidance	CSS color states
FR-015	Validation	Crew Density Check	Ensure adequate volume per crew member (minimum standards)	CRITICAL	HIDH crew volume req	Volume/crew calculation
FR-016	Analysis	Access Path Drawing	Tool to draw and measure pathways between modules	MEDIUM	Accessibility requirements	Path drawing tool
FR-017	Analysis	Distance Measurement	Measure distances between functional areas	MEDIUM	Emergency egress	Measurement overlay

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FR-018	Analysis	Zoning Compliance	Check placement of incompatible areas (e.g., noise vs. sleep)	HIGH	ISS crew feedback	Proximity rules
FR-019	Analysis	Redundancy Check	Validate critical system redundancy	HIGH	Mission safety	System duplication check
FR-020	Analysis	Mission Readiness Score	Calculate overall design readiness percentage	HIGH	Comprehensive assessment	Weighted scoring algorithm
FR-021	Visualization	2D Floor Plan View	Top-down 2D layout visualization	CRITICAL	Layout planning	Canvas/SVG rendering
FR-022	Visualization	3D Block Layout	3D visualization of stacked modules	HIGH	Spatial understanding	Three.js or Canvas 3D
FR-023	Visualization	Comparison View	Side-by-side comparison of 2+ designs	HIGH	Iterative design	Split-screen interface
FR-024	Visualization	Analytics Dashboard	Charts and metrics for design analysis	MEDIUM	Data-driven decisions	Chart.js integration
FR-025	Export/Share	Save Design (JSON)	Save habitat design to file	CRITICAL	Design persistence	JSON export
FR-026	Export/Share	Load Design (JSON)	Load previously saved designs	CRITICAL	Design persistence	JSON import
FR-027	Export/Share	Export PNG Image	Export high-resolution layout image	HIGH	Documentation	Canvas to image
FR-028	Export/Share	Generate PDF Report	Professional PDF report with specifications	HIGH	Presentation to judges	HTML to PDF
FR-029	Export/Share	Export 3D Model	Export .OBJ or .STL file for 3D printing	MEDIUM	Physical prototyping	3D model generation
FR-030	Export/Share	Share Design Link	Generate shareable URL for design	MEDIUM	Collaboration	URL encoding
FR-031	User Guidance	Tutorial/Onboarding	Interactive tutorial for first-time users	HIGH	Accessibility	Step-by-step guide
FR-032	User Guidance	Help System	Context-sensitive help and tooltips	HIGH	User support	Tooltip system

Req ID	Category	Requirement Name	Description	Priority	NASA Reference	Implementation Notes
FR-033	User Guidance	NASA Data References	Direct links to NASA source documents	MEDIUM	Data credibility	Hyperlinks
FR-034	User Guidance	Best Practices Tips	Suggestions based on NASA guidelines	MEDIUM	Design quality	Smart suggestions
FR-035	Presets	Mission Templates	Pre-configured templates (Artemis Base, Mars Transit, etc.)	HIGH	Quick start	Template library
FR-036	Presets	Launch Vehicle Constraints	Pre-loaded fairing dimensions for SpaceX, SLS, etc.	HIGH	Launch feasibility	Vehicle database
FR-037	Advanced	Auto-Optimize Layout	AI-suggested optimal layout based on constraints	MEDIUM	Innovation factor	Optimization algorithm
FR-038	Advanced	Keyboard Shortcuts	Power user keyboard shortcuts	LOW	Efficiency	Event listeners
FR-039	Advanced	Undo/Redo	Undo/redo design changes	MEDIUM	User experience	History stack
FR-040	Advanced	Autosave	Automatic saving of work in progress	MEDIUM	Data safety	LocalStorage backup

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NON-FUNCTIONAL REQUIREMENTS

Req ID	Category	Requirement Name	Description	Priority	Success Criteria
NFR-001	Performance	Fast Loading	Application loads within 3 seconds	HIGH	< 3s load time
NFR-002	Performance	Smooth Interactions	60 FPS for drag-and-drop operations	HIGH	No lag during interactions
NFR-003	Performance	Real-time Updates	Calculations update within 100ms	MEDIUM	< 100ms response
NFR-004	Usability	Intuitive Interface	No coding knowledge required to use	CRITICAL	Non-technical users succeed

Req ID	Category	Requirement Name	Description	Priority	Success Criteria
NFR-005	Usability	Mobile Responsive	Works on tablets and large mobile devices	MEDIUM	Responsive design
NFR-006	Usability	Accessibility	WCAG 2.1 AA compliance	MEDIUM	Screen reader compatible
NFR-007	Compatibility	Cross-Browser	Works on Chrome, Firefox, Safari, Edge	HIGH	All major browsers
NFR-008	Compatibility	No Installation	Runs entirely in web browser	CRITICAL	Web-based only
NFR-009	Data Accuracy	NASA Data Grounding	All specifications from official NASA sources	CRITICAL	Cited references
NFR-010	Data Accuracy	Realistic Calculations	Physics-based volume/mass calculations	HIGH	Validated formulas
NFR-011	Reliability	Error Handling	Graceful error handling without crashes	HIGH	No critical failures
NFR-012	Reliability	Data Validation	Input validation prevents invalid states	HIGH	All inputs validated
NFR-013	Scalability	Multiple Designs	Support 10+ saved designs per user	MEDIUM	Design library
NFR-014	Scalability	Complex Habitats	Handle 50+ modules without lag	MEDIUM	Performance maintained
NFR-015	Documentation	User Documentation	Clear README and user guide	HIGH	Complete documentation
NFR-016	Documentation	Code Comments	Well-commented codebase	MEDIUM	20%+ comment coverage
NFR-017	Visual Design	Professional UI	Modern, NASA-inspired aesthetic	HIGH	Judges impressed
NFR-018	Visual Design	Consistent Branding	NASA Space Apps Challenge branding	MEDIUM	Logo and colors
NFR-019	Innovation	Unique Features	At least 3 innovative features not in brief	HIGH	Standout capabilities
NFR-020	Innovation	Educational Value	Teaches space habitat design principles	HIGH	Learning objectives met

DATA REQUIREMENTS

Req ID	Data Element	Source	Format	Update Frequency	Notes
DR-001	ISS Module Volumes	NASA Technical Docs	JSON	Static	Destiny, Columbus, Node specs
DR-002	HIDH Guidelines	NASA Human Integration Design Handbook	JSON	Static	Crew volume requirements
DR-003	Launch Vehicle Fairings	SpaceX, NASA SLS, etc.	JSON	Static	Payload capacity constraints
DR-004	Crew Requirements	NASA Standards	JSON	Static	Per-person volume, mass, power
DR-005	System Mass Data	ISS ECLSS Specifications	JSON	Static	Equipment mass/volume ratios
DR-006	Power Requirements	ISS Power Budgets	JSON	Static	kW per system
DR-007	Mission Profiles	Artemis/Mars Campaign Docs	JSON	Static	Duration, crew size, destination
DR-008	Zoning Rules	ISS Crew Feedback	JSON	Static	Compatible/incompatible adjacencies
DR-009	Safety Standards	NASA Safety Requirements	JSON	Static	Redundancy, egress paths
DR-010	Material Properties	NASA Technical Memos	JSON	Static	Structural constraints

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TECHNICAL REQUIREMENTS

Req ID	Technology Area	Requirement	Implementation	Priority
TR-001	Frontend Framework	Pure HTML5/CSS3/JavaScript (no complex frameworks)	Vanilla JS or minimal libs	CRITICAL
TR-002	Graphics	2D Canvas or SVG for layout rendering	Canvas API	CRITICAL
TR-003	3D Visualization	Three.js for 3D views (optional enhancement)	Three.js CDN	MEDIUM

Req ID	Technology Area	Requirement	Implementation	Priority
TR-004	Charts/Graphs	Chart.js for analytics dashboard	Chart.js CDN	MEDIUM
TR-005	Data Storage	Browser localStorage for saving designs	LocalStorage API	HIGH
TR-006	File Handling	FileReader API for loading JSON files	FileReader	HIGH
TR-007	Export	Canvas toDataURL for PNG export	Canvas API	HIGH
TR-008	PDF Generation	HTML-to-Canvas-to-PDF library	jsPDF library	MEDIUM
TR-009	Drag-and-Drop	HTML5 Drag and Drop API	Native DnD	CRITICAL
TR-010	Responsive Design	CSS Grid and Flexbox	Modern CSS	HIGH
TR-011	Icons	Font Awesome or similar icon library	CDN	MEDIUM
TR-012	Hosting	GitHub Pages (free, simple deployment)	Git + GitHub	CRITICAL
TR-013	Version Control	Git for team collaboration	GitHub	CRITICAL
TR-014	Code Quality	ESLint for JavaScript linting	ESLint	MEDIUM
TR-015	Testing	Manual testing across browsers	Manual QA	HIGH

JUDGING CRITERIA ALIGNMENT

NASA Criterion	How We Address It	Priority	Differentiation Factor
Impact	Educational tool for students + professional designers	CRITICAL	Dual audience approach
Creativity	AI-powered auto-optimization, comparison views, mission templates	CRITICAL	Beyond basic requirements

NASA Criterion	How We Address It	Priority	Differentiation Factor
Validity	All data from official NASA sources (ISS, HIDH, Artemis docs)	CRITICAL	Scientific accuracy
Relevance	Directly supports Artemis & Mars campaigns	CRITICAL	Mission-critical tool
Presentation	Professional UI, comprehensive documentation, demo video	CRITICAL	Polished deliverable
NASA Data Use	10+ NASA data sources integrated and cited	CRITICAL	Deep integration

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DELIVERABLES CHECKLIST

Deliverable	Description	Format	Priority	Owner
Working Application	Fully functional web app	GitHub Pages URL	CRITICAL	Full Team
GitHub Repository	Well-organized codebase	Public repo	CRITICAL	Germany
README.md	Comprehensive project documentation	Markdown	CRITICAL	Poland
User Guide	Step-by-step tutorial	PDF/Markdown	HIGH	India
Demo Video	3-5 minute demonstration	MP4 (YouTube)	CRITICAL	France
Presentation Slides	Pitch deck for judges	PowerPoint/PDF	HIGH	Lebanon
Sample Designs	5+ example habitat layouts	JSON files	MEDIUM	Macedonia
NASA Data Citations	Bibliography of all sources	Markdown	CRITICAL	All
Technical Documentation	Architecture and code docs	Markdown	MEDIUM	Germany
Testing Report	Browser compatibility results	Document	MEDIUM	India

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MINIMUM VIABLE PRODUCT (MVP) - Phase 1

Must-Have for Submission:

- ✅ Habitat shape selection (3+ types)
- ✅ Dimension input with volume calculation
- ✅ Drag-and-drop module library (10+ modules)
- ✅ 2D floor plan visualization
- ✅ Real-time space utilization metrics
- ✅ Save/Load design (JSON)

- ✅ Export as PNG image
- ✅ NASA data integration with citations
- ✅ Responsive web interface
- ✅ Tutorial/help system
- ✅ Professional UI design
- ✅ GitHub Pages deployment

STRETCH GOALS - Phase 2 (If Time Permits)

Nice-to-Have Enhancements:

- 🌟 3D visualization with Three.js
- 🌟 Design comparison tool
- 🌟 Auto-optimize layout AI
- 🌟 Mission templates (Artemis, Mars)
- 🌟 PDF report generation
- 🌟 Multi-level deck support
- 🌟 Access path measurement
- 🌟 Zoning compliance checker
- 🌟 Share design via URL
- 🌟 Analytics dashboard

TEAM ROLE DISTRIBUTION

Team Member	Country	Primary Responsibilities	Skills
Member 1	Poland	Project Management, Documentation, GitHub	Organization
Member 2	India	Core JavaScript Logic, Data Structures	Programming
Member 3	Macedonia	UI/UX Design, CSS Styling	Design
Member 4	Lebanon	NASA Data Research, Content Writing	Research
Member 5	France	Video Production, Presentation	Media
Member 6	Germany	Technical Architecture, GitHub Pages	DevOps

TIMELINE (48-HOUR HACKATHON)

Time	Milestone	Activities	Deliverable
Hour 0-4	Setup & Planning	Repo setup, task assignment, data collection	Project structure
Hour 4-12	Core Development	Basic UI, module library, drag-drop	Working MVP
Hour 12-20	Feature Addition	Calculations, validation, NASA data	Full features
Hour 20-28	Enhancement	3D view, export, templates	Enhanced version
Hour 28-36	Testing & Polish	Bug fixes, responsive design, UX	Stable release
Hour 36-42	Documentation	README, user guide, video	Complete docs
Hour 42-46	Presentation	Slides, demo prep, final testing	Pitch ready
Hour 46-48	Submission	Final checks, submit, celebrate!	SUBMITTED! 🚀