# PROPOSAL GUIDELINES

NASA Spacesuit User Interface Technologies for Students

2024-2025





INSPIRE - ENGAGE - EDUCATE - EMPLOY
The Next Generation of Explorers

WWW.NASA.GOV/STEM

**Team Name**

Optional Team Logo

**Academic Institution Name**

Address

**Team Contact**

Student Name

Email Address

Phone Number

**Team Members**

(Please list ALL team members) Team

Member Name — Role

Email Address — Academic Year / Academic Major Team

Member Name — Role

Email Address — Academic Year / Academic Major Team

Member Name — Role

Email Address — Academic Year / Academic Major Team

Member Name — Role

Email Address — Academic Year / Academic Major Team

Member Name — Role

Email Address — Academic Year / Academic Major

**Faculty Advisor**

Name

Email Address

Phone Number

Faculty Advisor Signature                                            Date

Table of Contents

(Note: **We've limited the Technical Section to 12 pages**. Include enough images within those 12 pages to describe your software. If you want to submit additional images, use an Appendix. Other sections and appendices **will not count against your 12-page limit.**)

## 1. Introduction

The Extravehicular Activity and Human Surface Mobility Program and the Office of STEM Engagement at NASA's Johnson Space Center in Houston are proud to host another year of the NASA SUITS (Spacesuit User Interface Technologies for Students) Design Challenge. We will conduct in-person device testing onsite at Johnson tentatively from May 18-22, 2025.

This document serves as a resource and reference to help all potential NASA SUITS participants understand the requirements to enter and succeed in the challenge. Included are important steps to the challenge and required components of an official proposal. Please also review the Mission Description for NASA SUITS on our website https://go.nasa.gov/nasasuits.

## 2. Eligibility

Each prospective onsite team member must be enrolled as an undergraduate or graduate student at an accredited U.S. institution of higher learning (community college, military academy, technical college, or university). Note: enrollment verification may be requested and must be certified for participation at any time during the activity period.

- Team members must be 18 or older before arrival in Houston.
- Each team will be allowed eight badged participants for the onsite culminating event. These eight individuals MUST be U.S. Citizens or Legal Permanent Residents. While there is no limit on the number of participants for each team, institutions are encouraged to submit multiple different proposals if they have many interested students. *Note: In previous years, NASA has provided opportunities for non-badged participation in Houston. Currently, there is no plan to offer an offsite option for non-badged participants in 2025.*
- Each team must be accompanied onsite by the faculty advisor or an adult age 21 or older serving as the faculty advisor.
- All participants MUST attend the Orientation at 4 p.m. CST on December 12, 2024, and the Virtual Software Design Review on April 3, 2025.
- Team members may only participate with one team in the same competition.
- Student experiments must be organized, designed, and operated by student team members alone.
- All participants must be enrolled for the activity in STEM Gateway and have accepted the offer by the deadline provided by the NASA SUITS team.
- Interns involved in the design of a SUITS challenge may not participate as a member of a team in that same cycle of the SUITS challenge. However, they may serve as a team advisor.

## 3. Letter of Intent

**Submit a letter of intent by Thursday, October 10, 2024,** indicating the team's intention to submit a written proposal. You should follow the format below and write your letter in the body of an email. Send the email directly to NASA-SUITS@mail.nasa.gov. ***Teams may still submit a proposal even if they do not submit a letter of intent.***

- Provide team contact information — this should be a student team member.

a. Sample: Doe, John ([DoeJ@institution.edu](mailto:DoeJ@institution.edu)) Sophomore / Software Engineer

- Provide the academic institution (community college, military academy, technical college, or university) your team represents. Your team should designate a lead institution, even if members come from multiple institutions.
- State: "NASA SUITS Challenge Letter of Intent" in the subject line and body.

## 4. Proposal Requirements

- Each team must submit one electronic copy of an original proposal on the [NASA SUITS engagement opening](#) in NASA STEM Gateway **by Thursday, October 31, 2024**.
- You must submit each proposal in a three-section format containing the required sections in the following order: Technical, Outreach Plan, and Administrative.
- You shall not skip/omit sections or components under any circumstance.
- The Technical section shall not exceed 12 pages.
- The report body must use 12-point font.
- All information on the title page must be complete.
- You must label and reference figures and tables within the text.

## 5. Technical Section

The technical section must cover the design the team is proposing. This section must include any information that a technical reviewer will find informative or instructive in understanding the aims and goals of the design. Evaluators ranking the proposal for its scientific and technical merit will read only this section, so teams should address all relevant factors as listed below.

### a. Abstract

The abstract is a brief (up to 500 words) summary that touches upon the elements of the proposed prototype design and how they relate to the requirements and EVA scenario in the Mission Description. Include any planned testing of the design and any proposed hardware or peripheral devices your team would bring to on-site testing.

### b. Software and Hardware Design Description

Include a detailed description of the proposed software and how you plan to tackle each aspect of the design challenge, keeping in mind the context of the EVA scenario as stated in the Mission Description. Write in such a way that a practicing engineer or scientist can understand the design of the user interface (UI). Present goals along with a description of the expected key components of the product (e.g., system architecture plan, hardware concepts, network diagrams). Show conceptual UI design ideas (portrayed via wire frames, visuals, etc.) for navigation, telemetry, rover controls, geology, EVA task instructions, etc. Also, show any peripheral device mock-ups (e.g., external control methods, lighting methods) to help the technical reviewers understand the full scope of the proposed product. Be sure to highlight any unique solutions to the listed requirements your team is considering.

### c. Concept of Operations (CONOPS)

Describe the overall high-level concept of how your design will meet the expectations and requirements. Describe the system from an operational perspective (i.e., the viewpoint of the astronaut) to help facilitate an understanding of the system's goals. Address how the application will assist the design evaluator (or astronaut) in each of the aspects of the EVA scenario during testing. A flow chart of how your design operates throughout the mission may be a useful visual depiction. See the Mission Description document for more details on this section.

### d. Human-in-the-loop (HITL) testing

Discuss any pilot, user experience, human-in-the-loop, or human factors studies planned. A written HITL test plan should include a testing schedule (including dates and times of planned testing), test protocol, possible metrics/measures, feasible subject pools, expected population/demographics of test subjects, and all planned safety measures you will use while conducting HITL tests. Include how the HITL test will inform your team's development plan as they prepare for the analog EVA scenario, for example, planning for night/low-lighting testing, outdoor testing, and network/telemetry connection testing. A good HITL test plan will build towards a full test of the EVA scenario stated in the Mission Description before test week to identify any challenges ahead of the final test on-site. You do not need to repeat this section for both assets.

### e. Project Management

Provide an outline of the team's development plans, along with any internal key milestones.  Use a Gantt chart or similar chart. If following an Agile software development plan, outline your scrum schedule with a proposed feature development and testing plan. Describe how progress will be tracked to ensure that you meet the requirements of the EVA scenario in the Mission Description ahead of test week. Teams are strongly encouraged to plan time throughout their development period to test their devices in conditions close to that of the described EVA scenario before traveling to Johnson for test week. You do not need to repeat this section for both assets.

### f. Technical References

Cite referenced works in text and in a "References" section using formatting appropriate for a technical paper.


## 6. Outreach Section

The outreach section of the proposal includes the team's plan for disseminating the results of their experiment/experience to the public. Information contained in this section should focus on the outreach activities the team intends to implement and the target audience to address. The outreach plans must be original to the team. **Do not post original proposal documents on any social media platforms or channels.**

A plan is an organized way to achieve a specific objective. Random activities, even good random activities, do not constitute a plan. An outreach plan should have two major components:

- The **plan** — a description of the team's objectives and goals; what activities are planned for the upcoming year; where and when the activities will take place; what audience you are targeting, etc.
- The **activities** — what will the team do when they get there? What materials will they refer to? What are the main points that they will make?

For maximum point value, the plan should include the following:

- The team's objectives for each outreach activity.
- A description of the outreach audience (K-12 class or school groups, undergraduate research symposiums, university outreach to local schools, informal groups such as Boy/Girl Scouts, after-school clubs, church groups, etc.).
- Specific plans for activities (strengthened by alignment to state or national standards will help a K-12 teacher, or use of age/grade-appropriate language during the activity). Leading an "Hour of Code" in a classroom is the optimal outreach activity.
- Letters or agreements from institutions who accept your invitation to address their group.
- A press and/or social media plan.
- A connection between curriculum/activity and NASA SUITS, a NASA Mission, or the team's code.

## 7. Administrative Section

### a. Institutional Letter of Endorsement

This letter must be on the endorsing institution's letterhead and must come from the institution's president, dean of college, or department chair. It indicates the team's institution(s) has knowledge of the team's interest in participating in this activity and endorses the team's involvement. Failing to include a letter of endorsement from their institution(s) will result in a rejected proposal.

### b. Statement of Supervising Faculty

A statement of support from a faculty member indicating a willingness to supervise and work with the team during all stages of the activity. There will be no consideration for teams working without a faculty advisor. The faculty advisor must also sign off on the cover of the proposal as evidence that he/she has seen the proposal and approves of the submission. The following statement should appear on an institution letterhead and include the signature of the faculty advisor:

> As the faculty advisor for an experiment entitled "_____" proposed by a team of higher education students from _____ institution, I concur with the concepts and methods by which the students plan to conduct this project. I will ensure the student team members complete all project requirements and meet deadlines in a timely manner. I understand any default by this team concerning any project requirements (including submission of final report materials) could adversely affect selection opportunities of future teams from their institution.

If you comprise your team of students from more than one institution, submit the above from the lead institution. Additionally, supply a letter of support from a faculty member of each participating institution acknowledging that they are aware of the participation of their student(s).

## c. Statement of Rights of Use

These statements grant NASA, acting on behalf of the U.S. Government, rights to use the team's technical data, including computer software, and design concept, in part or in entirety, for government purposes. NASA, acting on behalf of the U.S. Government, may designate, for certain tasks under this engagement, that software (including documentation) developed for certain designated tasks be released as "Open Source" software, as the term is defined by the Open Source Definition promulgated by the Open Source Initiative on its website (see https://opensource.org/osd ). These statements are not required. However, teams with a Statement of Rights of Use will receive greater consideration in the proposal selection. If you choose to include these statements, all team members and faculty advisors must sign them. The statements read as follows:

> As a team member for a proposal entitled " _____" proposed by a team of higher education students from _____ institution, I will and hereby do grant the U.S. Government a royalty-free, nonexclusive and irrevocable license to use, reproduce, distribute (including distribution by transmission) to the public, perform publicly, prepare derivative works, and display publicly, any technical data contained in this proposal in whole or in part and in any manner for federal purposes and to have or permit others to do so for federal purposes only. Further, with respect to all computer software designated by NASA to be released as open source which is first produced or delivered under this proposal and subsequent collaboration, if selected, shall be delivered with unlimited and unrestricted rights so as to permit further distribution as open source. For purposes of defining the rights in such computer software, "computer software" shall include source codes, object codes, executables, ancillary files, and any and all documentation related to any computer program or similar set of instructions delivered in association with this collaboration. As a team member for a proposal entitled "_____" proposed by a team of higher education students from _____ institution(s), I will and hereby do grant the U.S. Government a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States Government any invention described or made part of this proposal throughout the world.

## d. Funding and Budget Statement

This section should include a simple columnar layout showing expected expenditures associated with the proposed design. These include materials, machining, operating, testing, shipping, etc. See Table 1 for an example. It is imperative that teams anticipate all costs involved and actively work to seek funding. List potential sources for funding, which can include institutional grants, state Space Grant funds, corporate sponsors, etc. Participants are responsible for **all** costs associated with their participation in the SUITS challenge, including but not limited to development, travel, lodging, and food. NASA SUITS will notify participants if any funding or student allowances become available.

*Table 1: SUITS Example Budget*

| Items | Costs |
|---|---|
| Flights | $4,500 |
| Hotel | $2,000 |
| Ground transportation | $400 |
| Operating | $600 |
| Software | $500 |
| Miscellaneous | $500 |
| **Total** | $8,500 |

### e. Hololens2 Loan Program

NASA SUITS has a limited number of Hololens2 devices we can loan to institutions. Please indicate your interest in a loaned device:

A) We do not require a loaned device because we either already have one or plan to acquire one.

B) We need a loaned device from NASA SUITS to participate.

C) We have a device but would still like you to consider us for a loan to aid in our development.
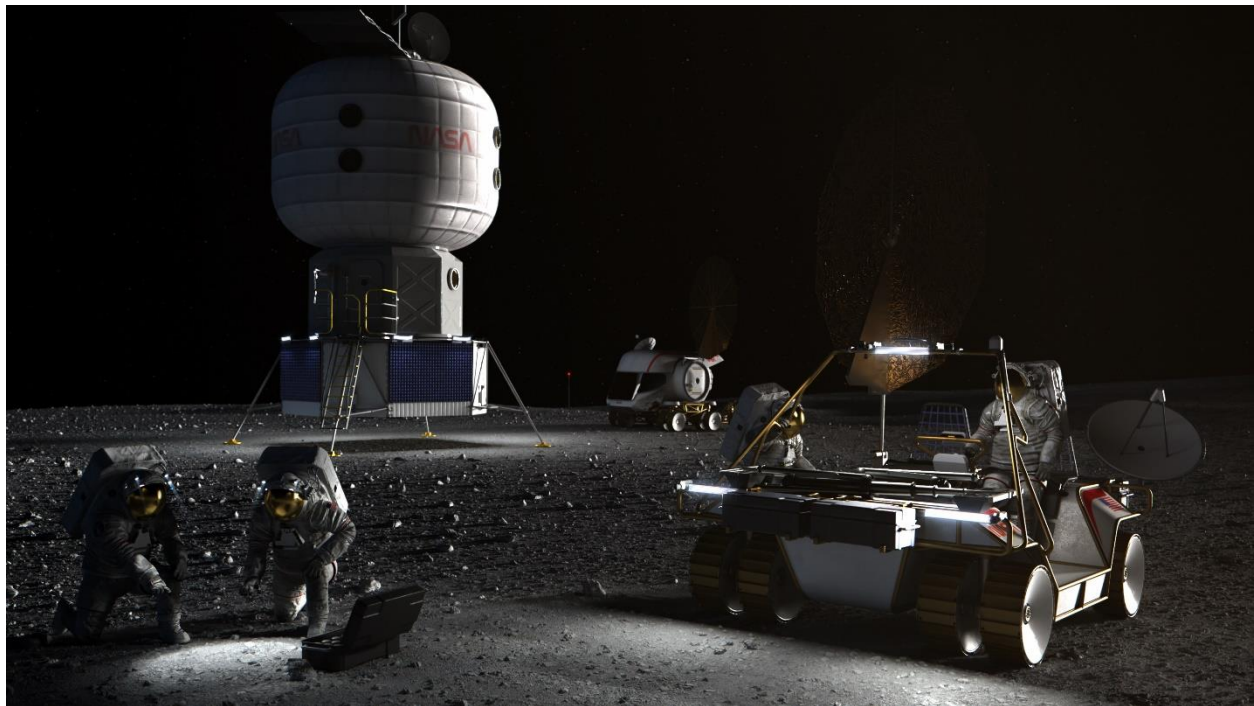
### f. Proposal Scoring Method

A scoring rubric, provided below, with required criteria will evaluate how well a proposal addresses each of the following required components: Technical Merit, Outreach Plan, and adherence to all proposal requirements.

### g. Other Deliverables

Teams will create a first-person point-of-view video of their UIs in action. Teams will submit this video, along with their code, during the software design reviews occurring in April 2025. Teams are also required to submit a draft of a white paper illustrating the development of their visual informatics display system upon completion of the NASA SUITS challenge in June 2025.

### h. Logo Use

Please supply NASA with logo files, preferably as .jpg or .png for your institution(s). Please provide both a version in which your school logo and name are displayed horizontally, as well as a version in which the logo and name are stacked vertically. Upload these files to your proposal in STEM Gateway. You may also provide a public-facing link to these files.

| PROPOSAL SCORING RUBRIC | Lowest Score ⟵⟶ Highest Score | | | | Score | Comments |
|---|---|---|---|---|---|---|
| **DESIGN DESCRIPTION**.<br>• Describe the goals of the design concept and expected results<br>• Provide roadmap for integrating AI for autonomous functions<br>• Tackle the following components of the challenge: UIs for both spacesuit and pressurized rover, navigation, and implementation of the autonomy and interoperability requirements<br><br>Total 30 points | **0-7 points**<br><br>The design concept description is insufficient or lacks clarity with respect to design goals and/or expected results. Proposer provides little to no evidence for an innovative UI design or display interaction method/technology.<br>At least one component of the challenge was met successfully. | **8-15 point**<br><br>The proposed design concept goals and/or the expected results of the design are vague. Proposer provides minimal evidence for an innovative UI design or display interaction method/technology.<br>At least two components of the challenge were met successfully. | **16-23 points**<br><br>The proposed design concept goals and/or the expected results of the design are generally described. Proposer provides some evidence for an innovative UI design or display interaction method/technology.<br>At least three components of the challenge were met successfully. | **24-30 points**<br><br>The proposed design concept goals and results are clearly and concisely written. Proposer demonstrates substantial evidence of innovative display interaction methods/technologies with visuals, etc., to support their concept. Most, if not all, components of the challenge were met successfully. | | |
| **CONCEPT OF OPERATIONS**<br>• Describe the user interfaces, autonomy, and interoperability from an operational perspective (Pressurized Rover and spacesuit)<br><br>Total 15 points | **1-3 points**<br><br>The proposed concept description of the user interface is <u>unclear and insufficient</u> from an operational perspective. | **4-7 points**<br><br>The proposed concept description of the user interface <u>contains few details and is difficult to comprehend</u> from an operational perspective. | **8-11 points**<br><br>The proposed concept description of the user interface <u>provides general details and provides a minimal or basic understanding of the concept</u> from an operational perspective. | **12-15 points**<br><br>The proposed concept description of the user interface is <u>clearly and concisely written in full detail and effectively explains the concept</u> from an operational perspective. | | |
| **FEASIBILITY**<br>• Concept demonstrates a viable solution to the technical need<br>• Plan describes how the concept would be produced<br><br>Total 10 points | **0-1 points**<br><br>The proposed concept <u>lacks viability</u> and/or fails to meet the technical need. <u>No evidence</u> is provided to demonstrate how the concept would be produced. | **2-4 points**<br><br>The proposed concept demonstrates <u>low viability</u> and minor/insignificant contributions to the technical need. <u>Little evidence</u> is provided to demonstrate how the concept would be produced. | **5-7 points**<br><br>The proposed concept demonstrates <u>sufficient viability</u> and describes some contributions to the technical need. <u>Minimal evidence</u> is provided to demonstrate how the concept would be produced. | **8-10 points**<br><br>The proposed concept demonstrates <u>high viability</u> and describes significant contributions to the technical need. <u>Ample evidence</u> is provided to clearly demonstrate in detail how the concept would be produced. | | |

| EFFECTIVENESS OF THE PROPOSED PROJECT SCHEDULE<br>• Comprehensive project schedule<br>• Effective use of available resources<br>• Labor distribution<br>• Documents proposed schedule for meeting objectives<br>• Detailed plan to achieve each objective or task<br>Total 5 points | 0 points<br><br>The proposed project schedule does not demonstrate effective planning. The plan includes little to no description for meeting objectives and completing the task. | 1-2 points<br><br>The proposed project schedule includes few details to demonstrate effective planning. The plan vaguely describes how to meet the objectives and complete the task. | 3-4 points<br><br>The proposed project schedule includes minimum details to demonstrate effective planning. The plan minimally describes how to meet the objectives and complete the task. | 5 points<br><br>The proposed project schedule is highly detailed and effective to meet objectives. Describes a comprehensive plan that demonstrates how to meet the objectives and complete the task. | | |
|---|---|---|---|---|---|---|
| HUMAN-IN-THE-LOOP (HITL) TESTING<br>• Provide a test plan for all HITL testing to be conducted by the team<br>• Include all the requested components for the HITL plan:<br>  • Schedule of proposed test events<br>  • Test protocol<br>  • Possible metrics/measures<br>  • Feasible subject pools<br>  • Expected population / demographics of test subjects<br>  • How test event evaluates design's ability to meet challenge requirements<br>• All HITL tests should be conducted safely<br>Total 10 points | 1-2 points<br><br>No HITL plan provided, or the components of the plan are insufficient, unsafe, or unclear. | 3-5 points<br><br>The proposed HITL plan includes a few of the components listed and deemed necessary to implement an effective and safe HITL test. | 6-7 points<br><br>The proposed HITL plan includes most but not all the components listed and deemed necessary to implement an effective and safe HITL test. | 8-10 points<br><br>The proposed HITL plan clearly and concisely describes each of the components listed and deemed necessary to implement an effective and safe HITL test. | | |
| TECHNICAL REFERENCES<br>• Referenced works are cited in text and are relevant to the proposal<br>• A bibliography is provided<br>Total 5 points | 0 points<br>No references are included. | 1-2 points<br>1 reference is cited. Not formatted correctly. | 3-4 points<br>At least 1 reference is cited. Citation(s) and reference entry(ies) follow a recognized format. | 5 points<br>2 or more references are cited. Citation(s) and reference entry(ies) follow a recognized format. | | |
| | | | | Total Technical Score | | |

| PROPOSAL SCORING RUBRIC | Lowest Score ←————————→ Highest Score | | | | Score | Comments |
|---|---|---|---|---|---|---|
| OUTREACH EVENTS<br>• Diverse list of events and activities planned<br>• Includes projected audience type and number of participants<br>• Detailed implementation plan<br>• Virtual outreach events are acceptable | 1-6 points<br><br>Only one outreach event is planned, or proposer provides no details of implementation plan, projected audience, and number of participants. | 7-13 points<br><br>Minimum of two outreach events are planned. Proposer provides minimal details of implementation plan, projected audience, and number of participants. | 14-19 points<br><br>Minimum of three outreach events are planned. Proposer provides a sufficiently detailed implementation plan including a projected audience, and number of participants. | 20-25 points<br><br>Minimum of four outreach events are planned. Proposer provides a highly descriptive and relevant implementation plan including a projected audience, and number of participants. | | |
| | | | | Outreach Total Score | | |

Note: Check the NASA SUITS website for the most-up-to-date activity documents http://go.nasa.gov/nasasuits.

Send questions and responses to NASA-SUITS@MAIL.NASA.GOV