



PROPOSAL GUIDELINES

NASA Spacesuit User Interface Technologies for Students

2023-2024



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

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(Note: **The Technical Section is limited to 10 pages.** Include enough images within those 10 pages to describe your tool. If you want to submit additional images, use an Appendix. Other sections and appendices **will not count against your 10-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 Spacesuit User Interface Technologies for Students (NASA SUITS) Design Challenge. We will conduct in-person device testing onsite at Johnson tentatively from May 19-23, 2024.

This document serves as a resource and reference to help all potential NASA SUITS participants with the requirements to enter and succeed. Included are important steps to the challenge and required components of an official proposal. Please also review the eligibility requirements for NASA SUITS at 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.
- To attend onsite testing activities, participants MUST be U.S. Citizens or Legal Permanent Residents. While there is no limit on the number of participants for each team, only five team members will be allowed onsite for the culminating events.
- All participants MUST attend the Orientation at 7 p.m. CST on December 14, 2023, and the Virtual Software Design Review on April 3, 2024.
- 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.
- 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 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 September 29, 2023, indicating the team’s intention to submit a written proposal. The letter of intent should follow the format below and be written 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) Sophomore / Software Engr
- 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](#) on the NASA STEM Gateway **by November 2, 2023**.
- Each proposal must be submitted in a three-section format containing the required sections in the following order: Technical, Outreach Plan, and Administrative.
- Sections or components shall not be skipped/omitted under any circumstance.
- The Technical section shall not exceed 10 pages including the title page.
- The report body must use 12-point font.
- All information on the title page must be complete.
- Figures and tables must be labeled and referenced 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 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 AR application 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 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 etc.). Show conceptual UI design ideas (portrayed via wire frames, visuals, etc.) for navigation, telemetry, rover controls, geology, and EVA task instructions. Also, show any peripheral device mock-ups (e.g., external control methods, lighting methods, etc.) 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 the UI will meet the expectations and requirements. Describe the system from an operational perspective (the viewpoint of the astronaut) to help facilitate an understanding of the system 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 to be used 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.

e. Project Management

Provide an outline of the team's development plans with any internal key milestones. Use a Gantt 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 the requirements of the EVA scenario in the Mission Description are met 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.

f. Technical References

Cite referenced works in text and in a "References" section using formatting appropriate in 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 is targeted, 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).

- Specific plans for activities (strengthened by alignment to state or national standards will help a K-12 teacher, use of the 5E Model, 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, Informatics and Subsystems team at Johnson, or the team’s code.

One emphasis of the NASA Office of STEM Engagement is a commitment to diversity. Therefore, teams will be evaluated for inclusion of students attending [Minority Serving Institutions](#) (MSI) as participants. These teams can be a sole MSI, or they can be a collaboration of institutions.

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 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 your team is composed 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 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 such certain designated tasks be released as "Open Source" software, as term is defined by the Open Source Definition promulgated by the Open Source Initiative on its website (see <http://opensource.org/docs/osd>). These statements are not required. However, teams with a Statement of Rights of Use will receive greater consideration in the proposal selection. If choosing to include these statements, all team members and faculty advisors must sign. 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 such as materials, machining, operating, testing, shipping, etc. See Table 1 for an example. It is imperative teams anticipate all costs involved and actively work to seek funding. List potential sources for funding and 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 and not limited to development, travel, lodging, and food. NASA SUITS will notify participants if any funding or student allowances become available.

Table 1 NASA SUITS Cost Example

<u>Items</u>	<u>Costs</u>
Flights	\$4,500.00
Hotel	\$2,000.00
Ground transportation	\$400.00
Operating	\$600.00
Miscellaneous	\$500.00
Total	\$8,000.00

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 to be considered for a loan to aide 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 2024. 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.

PROPOSAL SCORING RUBRIC	Lowest Score			Highest Score	Score	Comments
<p>DESIGN DESCRIPTION.</p> <ul style="list-style-type: none"> ✓ Describe the goals of the design concept and expected results ✓ Provide conceptual UI designs and innovative display interaction methods ✓ Tackle the following components of the challenge: UIs for both HMD and LMCC, egress task, navigation, RFID/Spectroscopy, ROVER, and implementation of the telemetry data for each of the assets <p>Total 30 points</p>	<p>0-7 points</p> <p>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. At least one component of the challenge was met successfully.</p>	<p>8-15 point</p> <p>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. At least two components of the challenge were met successfully.</p>	<p>16-23 points</p> <p>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. At least three components of the challenge were met successfully.</p>	<p>24-30 points</p> <p>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.</p>		
<p>CONCEPT OF OPERATIONS</p> <ul style="list-style-type: none"> ✓ Describe the user interfaces from an operational perspective (EVA astronaut and local mission control) <p>Total 15 points</p>	<p>1-3 points</p> <p>The proposed concept description of the user interface is <u>unclear and insufficient</u> from an operational perspective.</p>	<p>4-7 points</p> <p>The proposed concept description of the user interface <u>contains few details and is difficult to comprehend</u> from an operational perspective.</p>	<p>8-11 points</p> <p>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.</p>	<p>12-15 points</p> <p>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.</p>		
<p>FEASIBILITY</p> <ul style="list-style-type: none"> ✓ Concept demonstrates a viable solution to the technical need ✓ Plan describes how the concept would be produced <p>Total 10 points</p>	<p>0-1 points</p> <p>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.</p>	<p>2-4 points</p> <p>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.</p>	<p>5-7 points</p> <p>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.</p>	<p>8-10 points</p> <p>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.</p>		

<p>EFFECTIVENESS OF THE PROPOSED PROJECT SCHEDULE</p> <ul style="list-style-type: none"> ✓ Comprehensive project schedule ✓ Effective use of available resources ✓ Labor distribution ✓ Documents proposed schedule for meeting objectives ✓ Detailed plan to achieve each objective or task. <p>Total 5 points</p>	<p>0 points</p> <p>The proposed project schedule does not demonstrate effective planning. The plan includes little to no description for meeting objectives and completing the task.</p>	<p>1-2 points</p> <p>The proposed project schedule includes few details to demonstrate effective planning. The plan vaguely describes to meet the objectives and complete the task.</p>	<p>3-4 points</p> <p>The proposed project schedule includes minimum details to demonstrate effective planning. The plan minimally describes how the task and objectives will be met.</p>	<p>5 points</p> <p>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.</p>		
<p>HUMAN-IN-THE-LOOP (HITL) TESTING</p> <ul style="list-style-type: none"> ✓ Provide a test plan for all HITL testing to be conducted by the team ✓ Include all the requested components for the HITL plan: <ul style="list-style-type: none"> ○ schedule of proposed test events ○ test protocol ○ possible metrics/measures ○ feasible subject pools ○ expected population/demographics of test subjects ○ how test event evaluates design’s ability to meet challenge requirements ✓ All HITL tests should be conducted safely with the use of proper personal protective equipment <p>Total 10 points</p>	<p>1-2 points</p> <p>No HITL plan provided, or the components of the plan are insufficient, unsafe or unclear.</p>	<p>3-5 points</p> <p>The proposed HITL plan includes a few of the components listed and deemed necessary to implement an effective and safe HITL test.</p>	<p>6-7 points</p> <p>The proposed HITL plan includes most but not all the components listed and deemed necessary to implement an effective and safe HITL test.</p>	<p>8-10 points</p> <p>The proposed HITL plan clearly and concisely describes each of the components listed and deemed necessary to implement an effective and safe HITL test.</p>		
<p>TECHNICAL REFERENCES</p> <ul style="list-style-type: none"> ✓ Referenced works are cited in text and are relevant to the proposal ✓ A bibliography is provided. <p>Total 5 points</p>	<p>0 points</p> <p>No references are included.</p>	<p>1-2 points</p> <p>1 reference is cited. Not formatted correctly.</p>	<p>3-4 points</p> <p>At least 1 reference is cited. Citation(s) and reference entry(ies) follow a recognized format.</p>	<p>5 points</p> <p>2 or more references are cited. Citation(s) and reference entry(ies) follow a recognized format.</p>		
Total Technical Score						

PROPOSAL SCORING RUBRIC	Lowest Score			Highest Score	Score	Comments
OUTREACH EVENTS <ul style="list-style-type: none"> ✓ Diverse list of events and activities planned ✓ Includes projected audience type and number of participants ✓ Detailed implementation plan ✓ Virtual outreach events are acceptable 	1-5 points Only <u>one</u> outreach event is planned, or proposer provides <u>no details</u> of implementation plan, projected audience, and number of participants.	6-10 points Minimum of <u>two</u> outreach events are planned. Proposer provides <u>minimal details</u> of implementation plan, projected audience, and number of participants.	11-15 points Minimum of <u>three</u> outreach events are planned. Proposer provides a <u>sufficiently detailed</u> implementation plan including a projected audience, and number of participants.	16-20 points Minimum of <u>four</u> outreach events are planned. Proposer provides a <u>highly descriptive and relevant</u> implementation plan including a projected audience, and number of participants.		
MINORITY SERVING INSTITUTIONS (MSI) Teams containing students from a MSI will receive special consideration for participation in NASA SUITS. If the MSI is not the lead institution a letter of support from faculty at the MSI must be provided.	0 points The team does not include students from an MSI.			5 points The team does contain students from an MSI.		
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