Virtually Augmented Navigation Tool And Guidance for Egress

VANTAGE

Research, Engineering, and Design Teams

University of Nebraska - Lincoln

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1. Technical Section

1a. Abstract

The Virtually Augmented Navigation Tool And Guidance for Egress, or VANTAGE, is the submission from the University of Nebraska-Lincoln's Research, Engineering, and Design (RED) Teams for the 2024-25 NASA SUITS challenge. Developed for the Microsoft HoloLens 2, VANTAGE's purpose is to assist astronauts with Lunar missions in the future. It will provide functionality for Rover Navigation, Egress, Extravehicular (EV) Navigation, Geologic Sampling, and Ingress with an efficient, accessible user interface. Various tools will be used such as the TSS, DUST video feed, and graph search algorithms to ensure information is up-to-date and accurate, so astronauts on missions will have more information and useful tools at their disposal information such as markers, maps, camera feeds, and biometrics will be utilized to keep astronauts informed. By default, the amount of information present on screen will be limited to essentials, in order to ensure that there are not too many elements present at a time. Astronauts will have the capability to toggle various elements.

1b. Software and Hardware Design Description

Rover Navigation

The Rover Navigation system will leverage Dijkstra's algorithm, or a similar graph search algorithm, for efficient path planning, focusing on identifying the safest routes. This algorithm was chosen because of its ability to find the lightest path in a weighted graph. The "weight" assigned to each path will represent the difficulty of traversing from one node to another, based on potential hazards. Minimizing the edge weights translates into reducing danger, which is essential in the hostile lunar environment. To accurately determine these weights, we will use an AI model trained to differentiate between hazardous and less hazardous terrains. We will create software to measure factors such as speed, angle, and heading to plan around obstacles, terrain inclination, and craters, alongside other hazards. The training data will be based on simulations that mimic the lunar terrain the rover is expected to encounter. Since this AI model requires significant computational power, it will need to run over a Wi-Fi connection.

The data we will use is from the Digital Lunar Exploration Sites Unreal Simulation Tool (DUST). Through DUST, we are provided with the information necessary to determine the layout of the terrain. When a destination is selected, nodes will be dispersed between the current location and path in a grid pattern. Edges between nodes will be assigned weights from our AI model. Once the weights for various paths are established, Dijkstra's algorithm will be applied to determine the optimal route to our destination. This approach enhances the rover's autonomous navigation, integrating AI with an efficient path-planning algorithm. While this method will be our primary method of navigation, we will also use the virtual camera in order to detect any unforeseen obstacles. To do this, we can train another AI model to visually detect potential issues in the path. If an issue is detected, the rover will assess the level of risk present. If the level of risk exceeds the threshold set by the astronaut, it will stop and ask the astronaut for their determination on whether to continue or create a new path. We will also calculate how many resources and how long it will take to turn back from a certain point on our path to our end point to make sure the rover not only is able to make it to its destination, but also make it back, minimizing risk. Periodically, the rover will recalculate the path to ensure that the current path is still optimal and also recalculate the time it will take to get back. If a better path is found, then the rover will ask the astronaut whether to use the current or new path. Ultimately, the navigation system will be adaptive to current conditions, and focus on safety.

This information will then be fed into a trained model, which will assign weights to pathways based on hazard levels. This process effectively creates a map that we can use with our path-planning algorithm, ensuring the rover takes the safest, most efficient route from point A to point B. The rover can have multiple destinations to go to and at any time, the rover can be updated autonomously to go to a new destination, which will cause the rover to recalculate using the methods above and find the best way to the new destination. Once the destination is reached, the path can be followed in reverse to return.

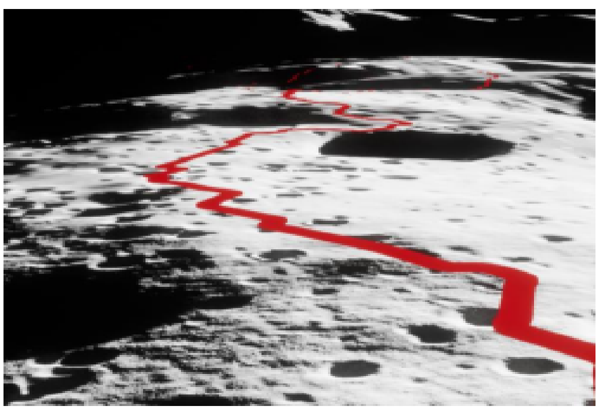


Figure 1: What the terrain and pathing might look like for the rover [1].

Rover UI

The User Interface (UI) will facilitate rover navigation and control within a simulated DUST environment [1], which represents the lunar terrain. The system will provide a real-time, intuitive display of rover positioning, control feedback, and efficient navigation maneuvering. We will utilize a live 2D map tracking human assets, including spacesuit locations for the duration of the Extravehicular Activity (EVA), the Lunar Terrain Vehicle's (LTV) projected and traversed paths when en route to its destination, and designated points of interest. The map will allow the user to add points of interest with pins on the map, and allow them to add more pins to the map with custom labeling that syncs to the heads-up display of the crew members for efficient crew management, caution and warnings, hazardous points, and mission timers.

The UI will enable crew members to directly control the autonomous navigation systems in which the LTV will utilize. With it, the crew members will be able to visualize and reset the best path, detect and avoid obstacles, receive updated destinations from TSS and other teams, and track rover speed, angle, and heading. When working inside the DUST environment, we will display route data to allow crew members to prepare for arrival at their destination. Additionally, we will display a front and rear facing camera to monitor what is directly in front of the LTV in case of failure. Essentially, this UI is the primary method where crewmembers will interact directly with the autonomous driving systems to control the LTV, without needing to pilot.

In order to enhance safety and communication, it will also display spacesuit telemetry for the crewmember biomedical data and spacesuit state data, as well as each crewmember's camera feed. Communication systems will be monitored and accessible to give direction to the crewmembers outside the LTV. In order to ensure that communications are not dropped, the connection quality to each crewmember will be displayed with a warning when the quality is too low. We will display elapsed mission times, elapsed time at each station throughout the EVA, and all mission timers shall adhere to the standard and constraints provided to selected teams. LTV Telemetry data will be shown here, as well as native camera feed. Task procedures will be displayed, which allows crewmembers inside the LTV to direct the flow of the mission and communicate tasks effectively for EV in the field. X-Ray Fluorescence (XRF) sensor data will be logged when the data has been collected by the EV in the field.

Resource utilization, life support systems and their health, rover resources such as power, core LTV systems, and predictive analytics on core systems and power will be shown, in order for the EV to extend the usage for each mission.

Rover Resource Management

To help with important decision-making, battery life will be tracked for the rover, with a time displayed of the estimated battery life left. When navigation routes are also planned for the rover, the battery usage will be estimated by taking the current wattage and battery capacity and making a rolling average, so the battery usage can be managed more effectively. Warnings will also be displayed if the battery level is getting low and putting the mission in jeopardy of not being able to retreat back to the rover without battery life depleting.

Heads Up Display

The Heads-Up Display (HUD) will be the primary viewing, controlling, and manipulating aide in completing EVA missions. The HUD will utilize the HoloLens 2, utilizing gestures to control the way astronauts interact with the UI (User Interface). The application will be built using Unity with a C# backend, as Unity will allow for the interactability that is necessary for such a tool to be built on the HoloLens 2.

The display will include elements depicting all Display and Control Unit (DCU) information, current tasks (in order), map information, and an operational compass. These displays have the purpose of making sure the user has easy access to information that needs to be quickly accessible while on mission. This information can include the subtask that needs to be done, the quickest/safest path to a location, and the status of important vitals. Warnings will also display if the user is running low on vitals.

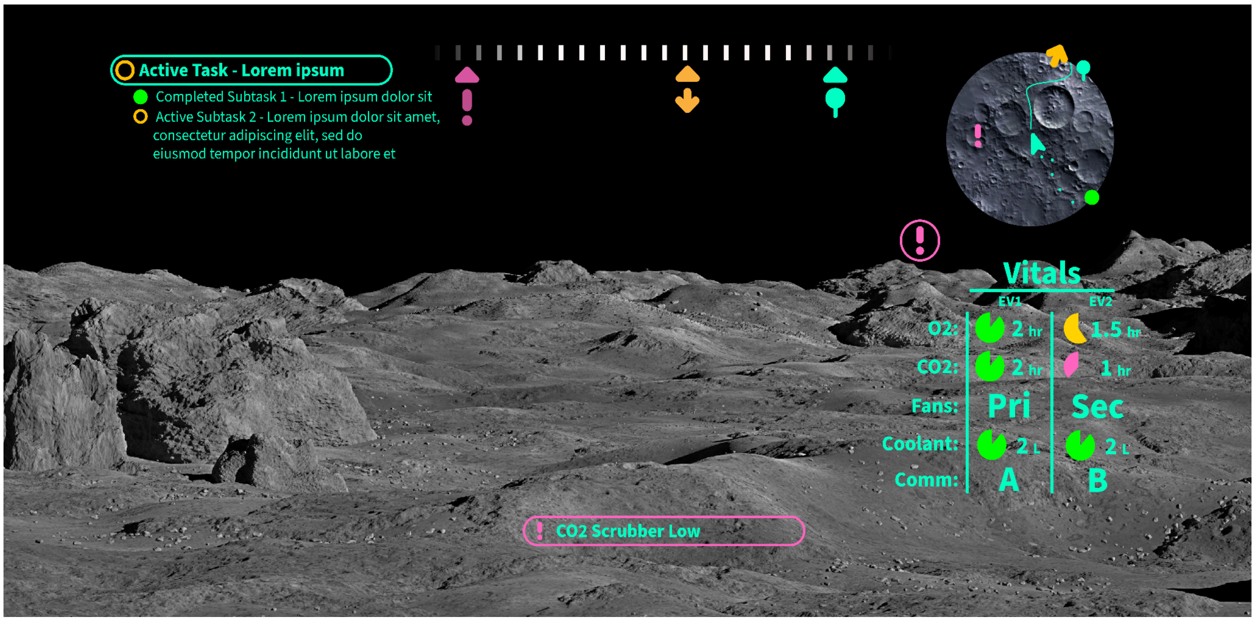
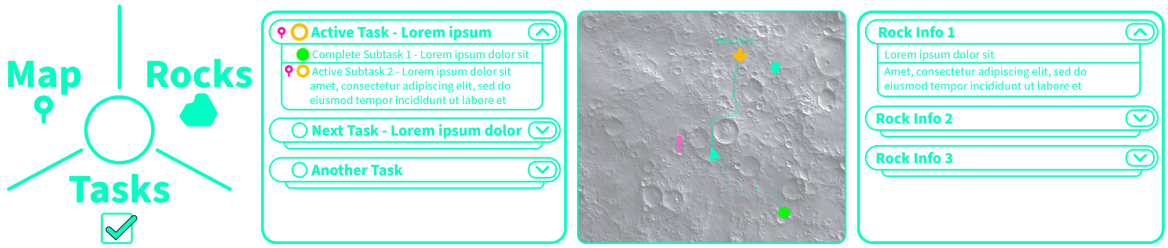


Figure 2: What the HUD would look like during the mission

Color is also employed to indicate significance. Cyan is used for the menus, while orange and pink are used sparingly to grab the user's attention. Locations, tasks, and warnings use different colors to signify importance. All text is still displayed in cyan to maximize readability, as cyan is one of the most readable and brightest colors to the human eye [2].

To help with usability, a palm menu will be employed that will be activated by holding a hand palm-up, which would cause the menu to appear. This menu will allow the user to select a specific category of information to interact with, including maps, tasks, and geological information. From the selected sub menu, the user will be able to adjust current display data as well as interact with mapping features, such as being able to drop pins on the map, select locations to be tracked and have best-paths made, and show tasks to be completed on the HUD. The submenus also would display important information pertaining to the topic of the menu, such as geological data from scanned rocks, specific task details, and the precise coordinates of locations marked on the map.

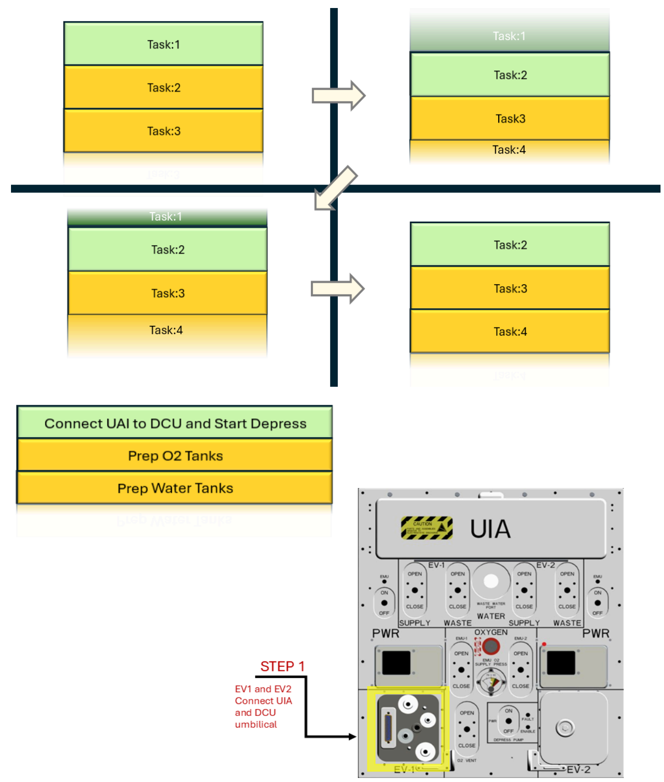


Figures 3-6: Palm menu and respective submenus.

Egress

As the astronaut is preparing to leave the airlock, their suit will walk them through the tasks of setting up their suit for the EVA. A checklist will pop up in their AR environment, informing them of the steps to complete each task. A tool will highlight where on the UIA the astronaut will need to connect their hose, or which switch needs to be flipped.

As each task progresses, a status bar will fill up, tracking the completion status via the telemetry system. As each step is finished, it will be automatically crossed off, and the next task will be moved into the to-do section. Once every task is finished, the suit will run a check using data from the telemetry system to make sure all the life-support systems are ready to go.



Figures 7-8: Logic behind task completion with the UIA for Egress.

Ingress

Once the user wishes to return to the rover, or all EVA tasks have been completed, or the life-support biomedical estimates reach a critical level, there will be an option to begin ingress procedures. In the case of critical life-support resources, this alert would interrupt any current task for the user's safety, ensuring they return to the pressurized rover in time. This will start by navigating the user back to the rover using any data gathered during EVA to ensure efficiency and safety. While the breadcrumb trail will be displayed, there will also be an 'optimized path' determined algorithmically via graph search, leveraging Dijkstra's algorithm. This path will be displayed to navigate the user back with the fastest and safest route. For clarity, this path will be displayed as a bright, cyan line projected onto the terrain. By using machine learning, resources can be conserved and safety can be maximized. When the astronaut is near the rover, the predetermined checklist will appear. Similarly to egress procedures, an interactive checklist will guide them through the steps of re-entry with the UIA, by highlighting various components.

Geological Scanning

Geological sampling will highlight samples and display geological data in a pinpoint view of information. This information will include specific characters of the geological sample, as well as an initial geologic interpretation. As part of the design, there will be a radial menu accessible by using the user's hand. This menu will display a detailed history tab of data samples collected prior, ways to place manual pins, and an index of geological information. It also will have pictures of samples taken by the HoloLens. We plan to receive the data through a telemetry stream, and parse through that data and send it to the UI to achieve these specific points.

1c. Concept of Operations (CONOPS)

The primary method of interactions that the user has with VANTAGE are hand gestures and virtual buttons. VANTAGE will allow the user to interact with the rover and designate a destination through gestures. Pointing to the destination will prompt the user to press a confirmation button. After this, when crew members are preparing for egress, a checklist will be displayed with the ability to mark tasks as completed. Each task will have a checkbox that can be checked off using a pointing gesture.

During the EV navigation, a trail back to the starting location will be visible. Information such as oxygen levels, objectives, and time remaining will be persistently visible. Astronauts can also view a 2D map in the top corner of their HUD. By using gestures, waypoints can be placed with a visible path to their location. Additionally, users have the option to view or disable telemetry, which is displayed in a box. With a menu to the side, crew members can access each other's information, as well as the rover's. At all times, a breadcrumb trail leading back to the location where egress began will be visible. Finally, the astronaut may return to their starting point by using a button, which will highlight the path back.

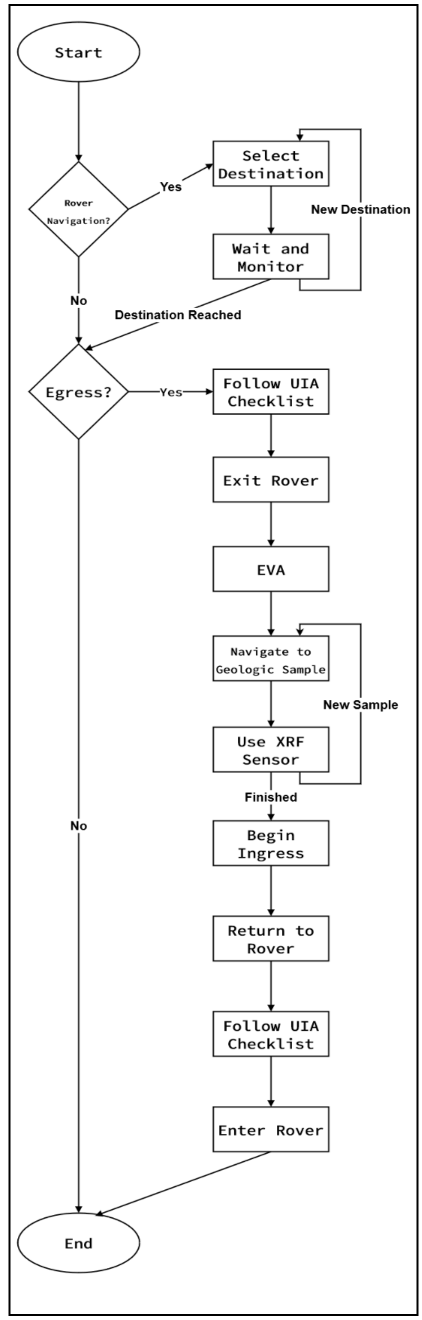


Figure 9: Flowchart of SUITS 2024-2025 mission

Interacting with the Rover UI, the user will be able to create new points of interests, select from several available paths to a location, and track the location, status, and camera feed of the rover and headset user. This, combined with the planned autonomous systems, will allow for autonomous and manual control when needed. With the planned live 2D minimap, the UI will be recognizable and easily learnable. The UI is designed to put all the info required for EVA support at the user's fingertips. The design intentionally draws on common design principles often seen in video games and modern professional applications, that many users find intuitive through experience.

1d. Human-in-the-Loop (HITL) Testing

Throughout the development period, we will conduct a series of usability tests. With every release, we will recruit new users to go through a 'mock' EVA activity. This activity will be done on an empty soccer field with harsh directional lighting provided by construction lights like those used at the Rock Yard at Johnson Space Center. The terminal applications will be tested in conjunction with AR tests.

The main metric we will be using to determine the success of a UI design is task completion time. Multiple tests will be run with different factors to compare things such as one-handed usability. Users will be made to carry MicroG Next tools from previous years (e.g., Maps, Tool Carrier and Scoop, and Sample Markers) while still completing AR based tasks. We will intentionally disconnect the Wi-Fi source being used to ensure system stability even in the event of a drop in network quality. Qualitative feedback will also be gathered to inform on what elements are hard or easy to utilize. Varying levels of communication with the terminal operator will be permitted to test how easy communication affects the use of the AR system.

Aside from formal testing, we will also utilize our outreach as a way to conduct learnability studies. When presenting our work to the public, we will invite them to participate in 'missions' designed to test the learnability of certain systems. This allows us to gather a large range of feedback from users who may not be as technologically savvy as your typical college aged student. In the past, some of the best feedback we have received has been from children aged 10-12, as they often identify when certain visual cues (such as an exit button) are not self-evident and need to be improved.

1e. Project Management

Our team plans on using an Agile development schedule. We will use the typical 2-week sprints, with releases every two to four sprints. Each release will focus on a major portion of VANTAGE. For example, in Release 1, we could focus on the Rover UI. Releases will include testing, both internal and external. Updates and modifications to code will go through project manager review and approval before being allowed to be committed to the VANTAGE repository.

The team will use Github as the online repository for development. This software allows members to create their own branches/versions of the program to easily let multiple features be worked on at the same time with little to no conflicts. The team will implement a redundant branch structure to ensure software integrity and quality, utilizing a development branch system to ensure bugs and errors are not present in the monthly testing as per the project timeline above. From this development branch, team members will branch off to work on specific issues and concepts as planned from the Taiga issue board used to manage the project sprints.

As a team, we will be tracking development via Taiga, a project management software. This software will let the team better track many aspects of the project as they develop it. Each major section of the project is assigned as an Epic, or a grouping of issues. These issues will follow a set of pipelines being: New Issues, Grooming Required, Product Backlog, Sprint Backlog, In Progress, Internal QA/Review, Advisor QA/Review, Done, then Closed. The issues that follow this production pipeline will be fleshed out with time estimates, completion requirements, development labels such as UI or environment, and which sprints/releases it is associated with. Once issues are groomed and the sprint they are associated with arrives, team members will work on issues they chose or have been assigned. As project work continues, members will create new issues as problems and new concepts are implemented or planned. By doing these tasks with the Taiga Board, the team will be more organized and strategic in our software development cycle.

To help visualize the schedule, a Gantt chart for the RED Teams SUITS sprint cycle has been created and included below.

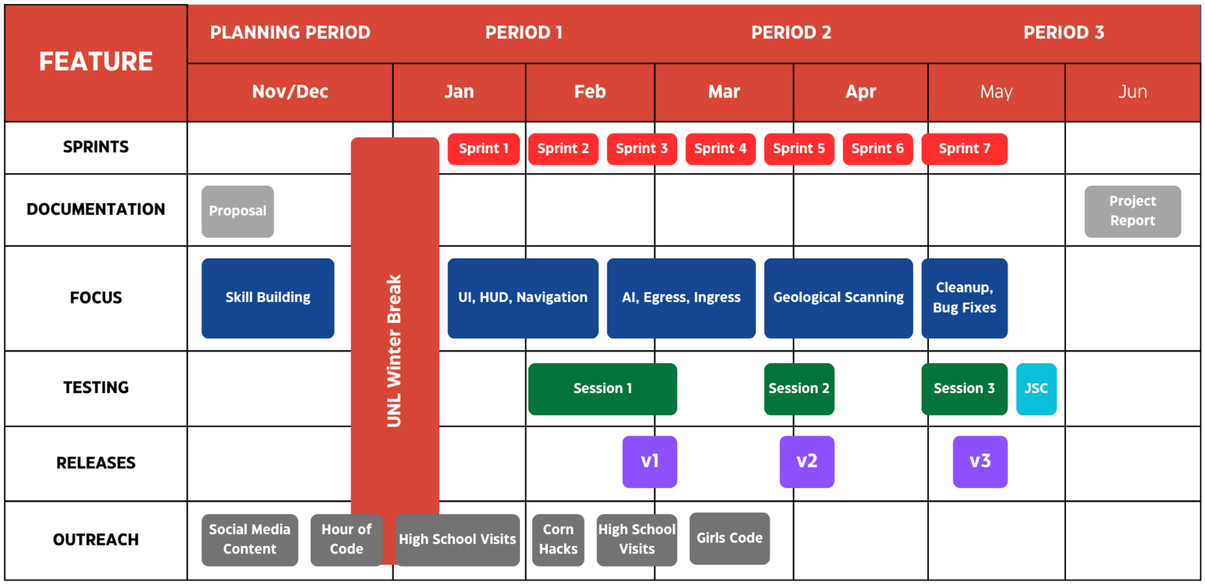


Figure 10: Gantt chart visualizing schedule for RED teams.

The project will follow seven sprint cycles that are divided into different focuses and releases. Aside from the focus before winter break, the focuses and sprints will follow a cycle of meeting certain points in the project where a new focus has been completed, and the next one has started. This is so there is some time to debug and fix previous focuses before each version is released, as seen in the testing sessions and release versions.

Before the first sprint cycle begins, the research and skill development focus will occur to help onboard new members of the project and create a project repository to start development in. Artificial intelligence will also be experimented with to start the process of developing a terrain warning system.

The second focus will occur over the first two sprint cycles, over about a month of time. It will focus on building the heads-up display, user interface, and navigation system for the HoloLens 2. The goal by the end of the month is to have a heads-up display that can navigate to a specific location that is given to it, utilizing a best path creation algorithm. The user interface will also have been built out, and vital information will be readily available, as well as the palm menu and warning system.

The third focus will be on developing the egress and ingress portions of the project, such that the full heads up display portion of the mission can be tested all the way through. During this period, the AI will also be developed to enhance the pathing system to avoid risky terrain by modifying the edge weights of the graphing algorithm.

After the third focus, the fourth focus will start to finish off the final touches of the main features of the project. It will focus on geological scanning, which will not take the full four weeks of time dedicated to it. Instead, during this time, debugging and testing will occur coinciding with the development of the geological scanning feature. This way, the project can be better prepared going into the final focus of the project, the dedicated testing and debugging.

A dedicated testing and debugging sprint is necessary to ensure the quality of the project. As such, this sprint is the longest single sprint in the project, and leads up to the trip to the Johnson Space Center. During this time, the testing and debugging from the previous portion of the project will continue, and final testing will occur the week before traveling to the center. From there, the project will be on standby to be built when the new telemetry stream sent to the SUITS team is sent to ensure the project is ready for on-site testing.

1f. Technical References

[1] L. Bingham, B. Weno, E. Paddock, J. Kincaid, N. Davis, C. Foreman, “Digital Lunar Exploration Sites Unreal Simulation Tool (DUST),” NASA, September 2022. Available: https://ntrs.nasa.gov/api/citations/20220014707/downloads/DUST_IEEE2023Paper.pdf [Accessed October 2024].

[2] C. Dyer, “Color and Color Vision,” University of Wisconsin - Madison, November 2004. Available: https://pages.cs.wisc.edu/~dyer/ah336/papers/06_color.pdf [Accessed October 2024].

2. Outreach Section

UNL RED Teams has a long history of outreach that we plan to continue with our participation in NASA SUITS. Our outreach will focus on Middle–High School students in both the local Lincoln area and our members’ hometowns. We plan to do 2–2.5 hour programming courses where we will walk students through some basic programming concepts, eventually culminating in a graph search algorithm that will be used in the VANTAGE software, and then shown to the students. These programs will demonstrate the value of STEM concepts and how they can be used to solve real world problems.

We will also do more brief events like Lincoln Code and Girls Code Lincoln where we will simply show off VANTAGE and our past project MORTI. These will show what can be done with STEM and serve to inspire students to pursue STEM. These events typically reach large numbers of students, upwards of 120 per event. Ages often range from 7 to 18. It is also an amazing opportunity to test learnability and usability. We set up a mock ‘mission’ for students to complete, and typically the students have very useful feedback as to what is or is not easy to use.

Below is a list of planned events.

Location	**Date Planned**	**Expected Students**	**Event Type**
Party at the Union	Aug 24	100–150	MORTI Showcase
Rock the Block	September 5th	75–100	MORTI Showcase
Hour Of Code @ Nebraska & Tech Fair	December 7th	100–150	VANTAGE Showcase
Parnassus Preparatory School	January 15th	15–20	Programming Instruction
Maple Grove High School	January 16th	20–25	Programming Instruction
Corn Hacks	February 17th-18th	25–35	Hackathon
Lincoln High School	February 20th	30–35	Programming Instruction
Elkhorn South High School	February 25th	45–50	Programming Instruction
Girls Code Lincoln	March 10th	10–15	Programming Instruction
Social Media	Continuous	N/A	Postings of updates of team and NASA achievements on 𝕏 (formerly known as Twitter) and Instagram platforms.

3. Administrative Section

3a. Institutional Letter of Endorsement

SCHOOL OF COMPUTING

October 30, 2024

To NASA Office of STEM Engagement,

My name is Witawas Srisa-an, and I am the Director of the School of Computing at UNL. I am writing to confirm my awareness of our RED team's interest in participating in the NASA SUITS program, and I would like to express our full support from the School of Computing for their involvement.

If you have any questions regarding our support, please feel free to contact me.

Sincerely,

Witawas Srisa-an, Ph.D.

Director, School of Computing

University of Nebraska Lincoln

The School of Computing
256 Avery Hall, Lincoln, NE 68588 | 402.472.2401 | info@cse.unl.edu
computing.unl.edu

3b. Statement of Supervising Faculty

October 21st, 2024

To Whom It May Concern:

I am the faculty advisor for **Team VANTAGE**, a College of Engineering's Research Engineering and Design (RED) team at the University of Nebraska-Lincoln. The team successfully proposed and delivered an augmented reality (AR) application as part of the NASA SUITS challenge in 2022-23, testing and presenting their project at the Johnson Space Center.

I am proud to once again serve as the advisor as the team submits their latest proposal for the NASA SUITS challenge this year. I am confident in their proposal, its methods, and concepts. I will ensure that all reports and deadlines are completed by all student members in a timely manner. I understand that any default by this team concerning any program requirements (including submissions of final report materials) could adversely affect selection opportunities of future teams from UNL.

Sincerely,

Dr. Christopher M. Bourke
Professor of Practice
School of Computing
University of Nebraska–Lincoln

Nebraska Lincoln
School of Computing
256 Avery Hall | Lincoln, NE 68588-0115 | 402.472.2401
computing.unl.edu

3c. Statement of Rights of Use

As a team member for a proposal entitled "VANTAGE" proposed by a team of higher education students from the University of Nebraska-Lincoln 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 “VANTAGE” proposed by a team of higher education students from the University of Nebraska-Lincoln institution(s), I will and hereby do grant the U.S. Government a nonexclusive, non-transferable, 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.

Signed,

Rishi Krishnamoorthy 10/27/24

10/30/2024 10/29/24 10/29/24

Chloe 10/29/24 Asher 10/31/2024

10/29/24 Michael DeJournett

Luke Uhlir 10/30 Spencer Lewis 10/21/2024

3d. Funding and Budget Statement

Table 1 displays the club's planned operating budget for this project. This budget includes all design, development, outreach, and travel costs the club plans to incur. This budget is subject to change as development begins. Table 2 delineates secured and planned funding sources and their monetary amounts.

Table 1: Draft Budget

Category	Item	Cost	Description
Travel Expenses	Hotel	$1,000.00	2 rooms for 8 people for 5 days
	Van Rental & Gasoline	$750.00	Driving from Lincoln, NE to Houston, TX and traveling within Houston
	Food	$800.00	Food for 8 people for 5 days
Development Software(s) and Tools	CI/CD Integration Software	$250.00	Continuous integration software for Unity development
Misc. Operating Costs	Outreach Events	$250.00	Funding for travel and materials associated with outreach events
Total Amount	Total Cost	$3,050.00	

Table 2: Funding and Sponsorships

Category	Source Category	Amount	Description
UNL Engineering Advisory Board (eSAB)	Funding from the UNL College of Engineering	~$3,000.00	Funding must be used by the end of Summer and can be dedicated to materials, licenses and travel expenses. Funding is to be requested in Spring 2024, with a requested amount of $3000.00 for project expenses and travel.
NASA Nebraska Space Grant	NASA	TBD	R.E.D. Teams will apply for and hope to receive a grant for materials, tools, and travel.
Glow Big Red Fundraiser	University Sponsored Fundraiser	$250.00	Funding dedicated to purchasing of club apparel and outreach.
NASA Milestone Stipend	NASA	$1,000.00	Estimation from previous stipends awarded to other student design programs like NASA Micro-G NeXT, which offer an assistive stipend for hitting milestones on time. Will be used to fund lodging.

Sandhills Global Sponsorship	Sandhills Global	$500.00	Sponsorship from Sandhills Global to assist NASA SUITS. Will be used to purchase lodging and food.
Total Amount	Total Cost	$4,750.00	

3e. HoloLens2 Loan Program

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

3f. Proposal Scoring Rubric

Technical Proposal Scoring Rubric	Score	Comments
DESIGN DESCRIPTION. • Describe the goals of the design concept and expected results • Provide roadmap for integrating AI for autonomous functions • Tackle the following components of the challenge: UIs for both spacesuit and pressurized rover, navigation, and implementation of the autonomy and interoperability requirements Total 30 points		
CONCEPT OF OPERATIONS • Describe the user interfaces, autonomy, and interoperability from an operational perspective (Pressurized Rover and spacesuit) Total 15 points		
FEASIBILITY • Concept demonstrates a viable solution to the technical need • Plan describes how the concept would be produced Total 10 points		
EFFECTIVENESS OF THE PROPOSED PROJECT SCHEDULE • Comprehensive project schedule • Effective use of available resources • Labor distribution • Documents proposed schedule for meeting		

objectives • Detailed plan to achieve each objective or task Total 5 points		
HUMAN-IN-THE-LOOP (HITL) TESTING • Provide a test plan for all HITL testing to be conducted by the team • Include all the requested components for the HITL plan: • 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 Total 10 points		
TECHNICAL REFERENCES • Referenced works are cited in text and are relevant to the proposal • A bibliography is provided Total 5 points		
Technical Total Score		

Outreach Proposal Scoring Rubric	Score	Comments
OUTREACH EVENTS • Diverse list of events and activities planned • Includes projected audience type and number of participants • Detailed implementation plan • Virtual outreach events are acceptable		
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.		
Outreach Total Score		

3g. Other Deliverables

We will deliver the UI video by the design review in April 2025, as well as the white paper in June 2025.

3h. Logo Use

Logos are included below, as well as submitted as part of the proposal.

Horizontal Word mark:

UNIVERSITY OF Nebraska® Lincoln

Square Logo:

N®

3i. Images

Images and figures used throughout the proposal are listed below.

Figure 1:

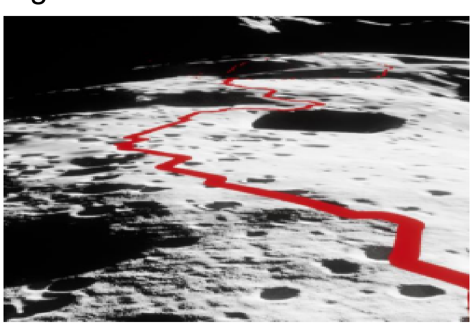


Figure 2:

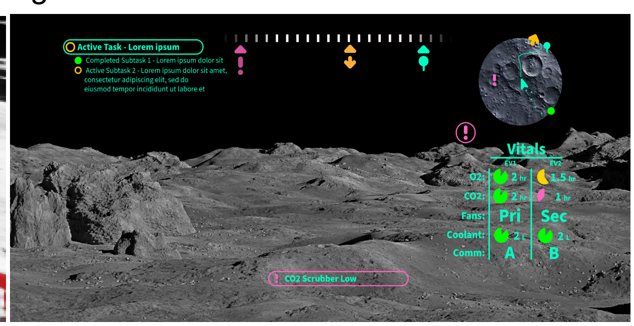


Figure 3:

Figure 4:

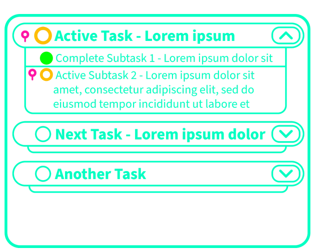


Figure 5:

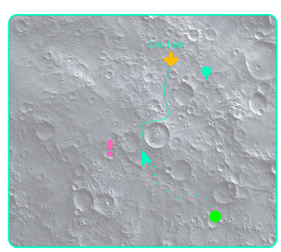


Figure 6:

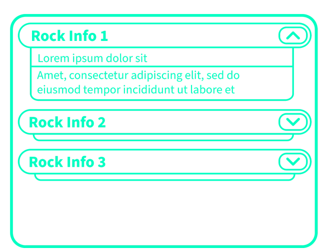


Figure 7:

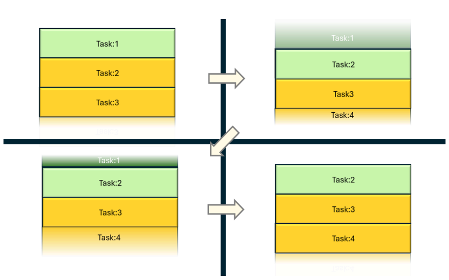


Figure 8:

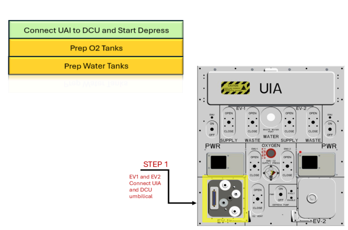


Figure 9:

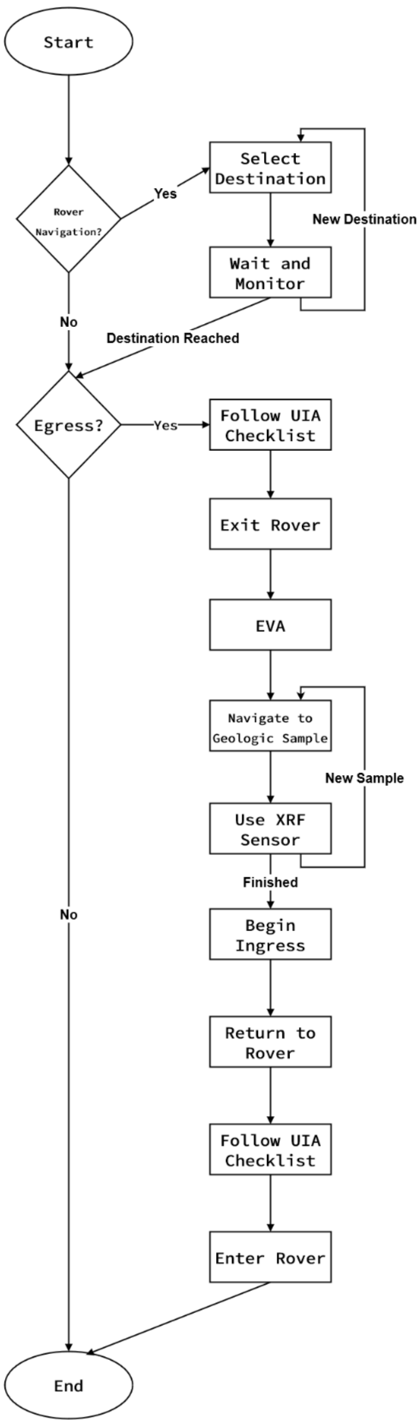


Figure 10: