Surface Autonomous Vehicle for Initial Search and Rescue Response (SAVISARR)

Team: The Buckeyes of the Galaxy

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I. Technical Section

A. Abstract

In the event of an unplanned egress during Orion's ascent to the moon, it is essential that stranded crew members are located and provided with life-saving supplies in a timely fashion. This proposal discusses the design for an autonomous vehicle referred to as SAVISARR (Surface Autonomous Vehicle for Initial Search and Rescue Response) to deliver these supplies in a marine environment. The vehicle will be dropped by a UAV near the landing area where it will then track the ANGEL's 121.5 MHz distress signal equipped on any isolated crew member's life vests. Otherwise, it will run through an expanding search pattern until the signal is discovered. The design consists of four components - the hull, signal tracking, control systems, and the propulsion system. Our design is lightweight, cost-effective, and adjustable.

B. Design Description

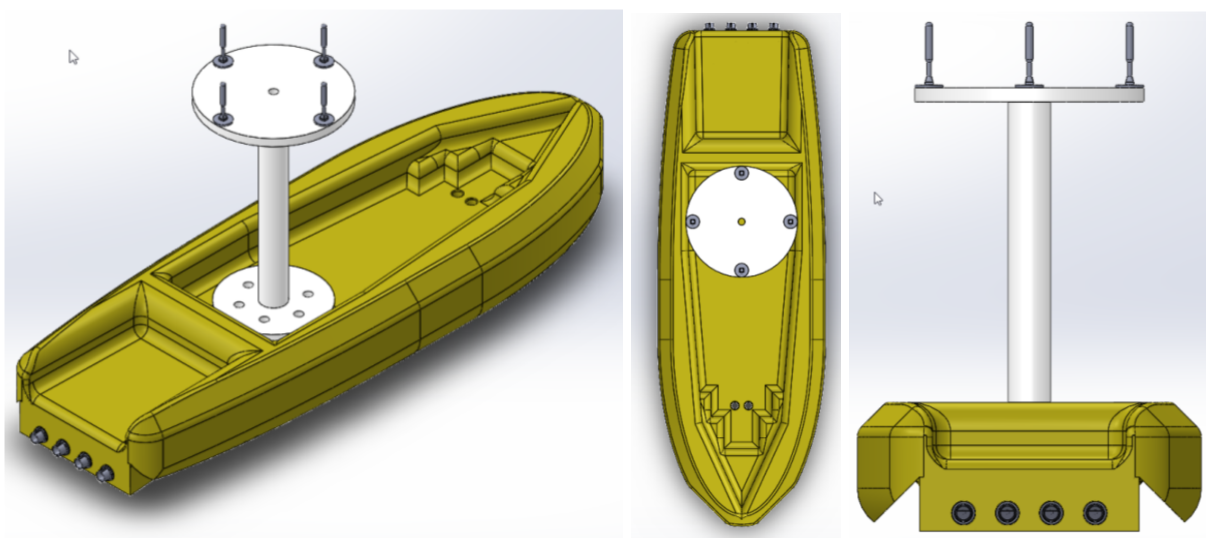

Figure 1: SAVISARR V1 CAD Photos

Hull Structure

The hull of the device is a modified 6 feet by 2 feet by 9 inch kayak with a weight of 18 lbs and a capacity of 130 lbs. The hull has a reverse chine design on both sides to increase stability significantly and provides it the ability to traverse bigger waves and rougher conditions.

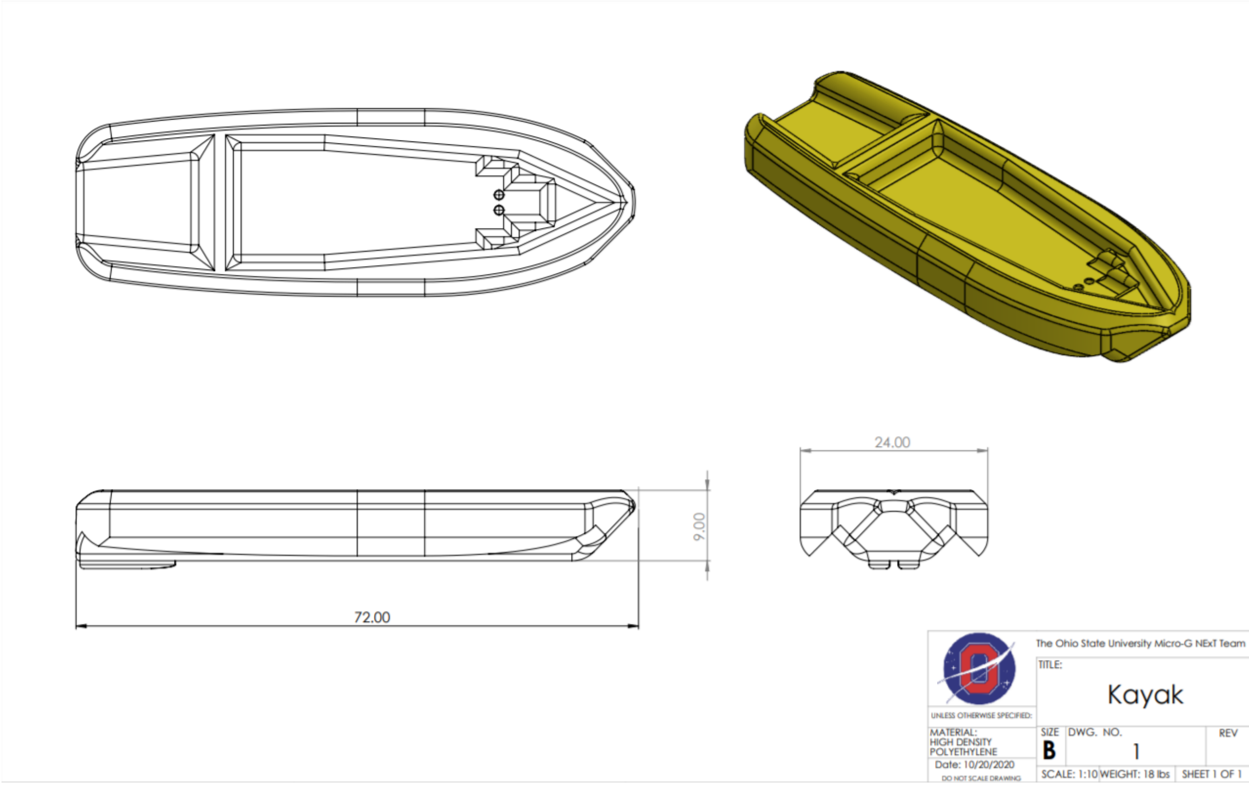

Figure 2: Kayak Hull Drawing

The propulsion will take up the back end of the hull; the controls system and power will be forward of the propulsion bulkhead. The front and midsection of the hull will be dedicated to cargo space for the required supplies. The radio platform will be a 16-inch diameter disk ~2 feet above the hull supported by a 12-inch base disk. A 3-inch diameter PVC tube will be going through both disks and attaches to the lower hull and through the roof.

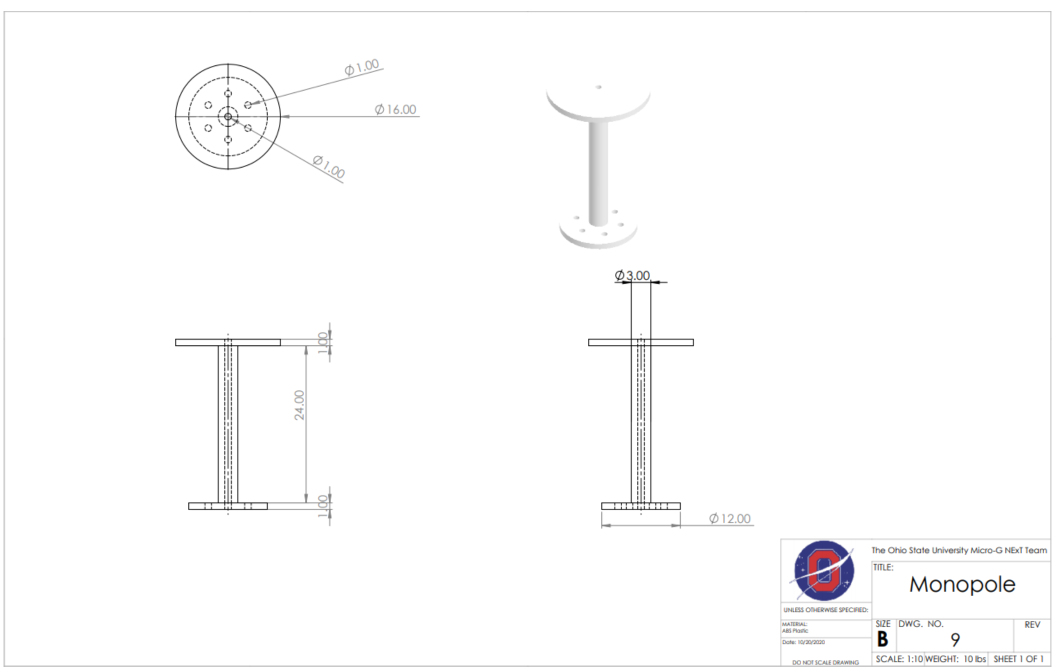

Figure 3: Monopole Drawing

Signal Tracking

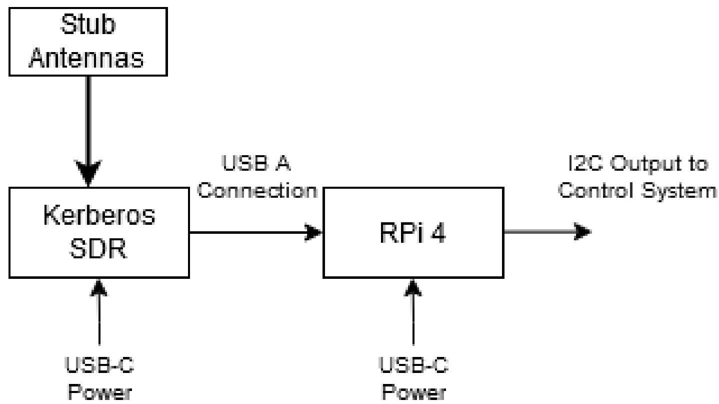

Figure 4: Signal Flow Diagram

To track ANGEL's 121.5 MHz emergency frequency, we use a pseudo-doppler RF direction finding setup as defined in [1]. To implement the outlined system, we will use a Software Defined Radio and a Raspberry Pi 4. We found that the Kerberos SDR was a perfect match for this application, as it has four separate RF inputs that allow for fast and consistent switching between the four antennas in our antenna array. We use magnetic whip stubs as they are cost-effective and have a small enough gain to avoid loss in the effective area covered due to turbulence.

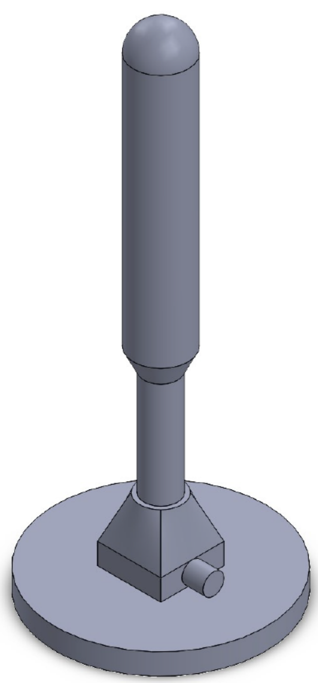

Figure 5: Magnetic Whip Antenna CAD

The four stub antennas are placed on top of the circular disk on a monopole in the center of the boat at a radius of 6 inches. The accompanying open-source software [2] allows us to synchronize the stub antennas to ensure accurate reading, filter the 121.5MHz RF signal, and process it into bearing data. The direction of arrival is determined using the MUSIC (MUltiple SIgnal Classification) algorithm as defined in [1, 3]. After the signal is processed through the Raspberry Pi, two bytes of bearing data are sent to the boat's control system via the I^2C serial protocol. GPIO pins 2 (Serial Data) and 3 (Digital Clock) on the RPi 4 are used for this purpose. With the Raspberry Pi control, we can continue tracking the signal in the event of an antenna malfunction or break. We can do this by sampling exclusively from the two antennas adjacent to the broken antenna to achieve (less accurate) bearing data. With the antenna array approximately 2.5 feet from sea level, our effective range is limited by line of sight. This means we can track the ANGEL signal within about 1.75 nautical miles.

Control Systems

The control system will consist of two separate computers. The RF computer and the Navigation computer. The RF computer is described above. The navigation computer is a Teensy 4.1 and will be responsible for all other functions. This includes motor control, mission profiles, telemetry, and GPS communications. As the Raspberry Pi is not an embedded system, it has a chance of lagging or failing. In the event of a failure, the Teensy 4.1 will still run vital functions.

The Navigation computer will have multiple sensors. The most important sensor is the RF stub antennas as outlined in the Signal Tracking section. The next important sensor is an MPU9150. This sensor has a 3 axis magnetometer, 3 axis gyroscope, and 3 axis accelerometer. The MPU9150 is required to detect splashdown as well as the position and heading of the craft. A GPS module is required to execute mission profiles and search patterns. A DJI NAZA sensor or an MTK3339 chipset would fulfill this requirement.

There will be LED indicators on the outside of the craft to give quick information on the state of the craft. If the craft isn't close enough to be able to read the LED status lights it will be able to communicate with a ground station computer through a telemetry link. The link will be over 900MHz using RFM95 radios and dipole antennas. The telemetry link will contain the GPS position, yaw, pitch, roll, astronaut locked status, the bearing from the craft to the Astronaut if locked, battery voltage, and other sensor data. This telemetry link is useful but is not required for the operation of the craft.

Propulsion

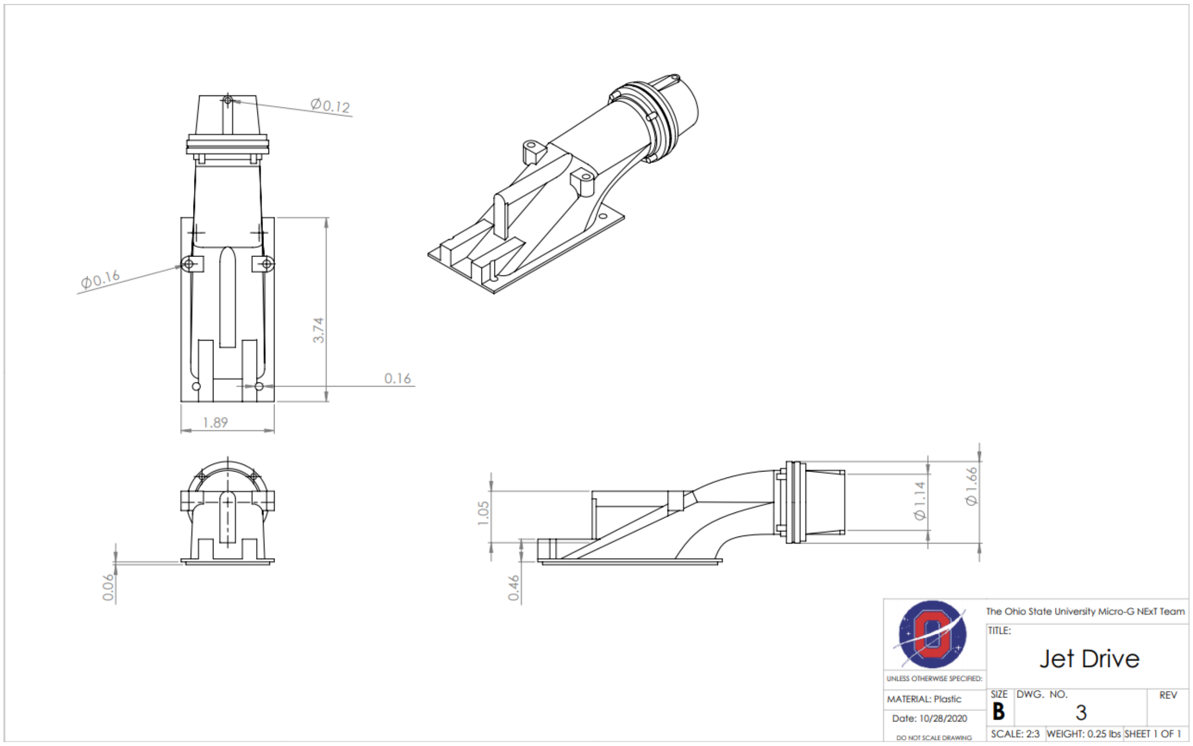

Figure 6: Jet Drive CAD Drawing

The propulsion of our device consists of four in-line jet drives, four motors, and four water-cooled electronic speed controllers. The jet drives are 172.3mm x ~42mm x 55 mm, the water intake is 86.3mm x 39.3mm, and the output is a 25mm nozzle. Driving the jet drives are four 3660 motors with a KV of 1620 allowing the device to have 64800 RPM per jet drive. The electronic speed controllers. The entire propulsion system is powered by two 5s (5 cells in series) batteries providing 42 volts with a capacity of 8 Ah(amp-hours). The battery is 169mm x 69mm x 39mm; two will take up 169mm x 138mm x 39mm. During operation, the device won't pull the maximum current it is capable of to conserve battery and to maintain a safe speed. It is also designed so that in the event of a failure of a jet drive, the other jet drives compensate to maintain heading and speed.

Future Design Considerations

- Stronger, deployable antenna system
- Exterior safety foam
- A keel to increase stability
- Using directional antennas

Table 1: Bill of Materials

Part Number	Part Name	Quantity	Part Material	Manufacture Origin
1	Kayak Hull	1	High-Density Polyethylene	COTS and Modified
2	5s LiPo Battery	2	Lithium Polymer Cells	COTS
3	25mm Jet Drive System	4	Plastic, Aluminum, and Carbon Fibre	COTS
4	Electronic Speed Controller	4	Aluminum and PCB	COTS
5	3660 Water-Cooled Brushless Motor	4	Metal	COTS
6	Kerberos SDR	1	PCB	COTS
7	Raspberry Pi 4	1	PCB	COTS
8	Raspberry Pi 4 Housing / Cooling	1	Aluminum and Plastic	COTS
9	Monopole	1	PVC and ABS	Manufactured in house
10	Magnetic Whip Antenna (RTL2832U)	4	Plastic and metal	COTS
11	Telemetry Radio (RFM95)	2	PCB	COTS
12	Teensy 4.1	1	PCB	COTS
13	Multi-use LED Indicator System	6	PCB	Manufactured in house
14	MPU 9150	1	PCB	COTS

C. Operations Plan

Testing of the SAVISARR will evaluate how well it tracks a signal, executes search patterns, and effectively switches between modes of operation. The first stage of testing will evaluate how well the device switches from “landing mode” to “splash and dash” mode. This will require the device to be dropped from the crane before driving to a pre-programmed location 20 feet away. The second stage of testing will evaluate how well the device can switch from landing mode to tracking mode. This will require that the device be dropped from the crane near an active distress beacon. The third stage of testing will evaluate how well the device switches from landing mode to search mode. This will require the device to be dropped from the crane where it will then execute its default search pattern after failing to detect the distress signal. The fourth stage of testing will evaluate how well it switches from search mode to tracking mode. An active distress beacon will be activated after the device has executed its search pattern for a minute. The fourth stage of testing will be an extensive test evaluating the optimal signal magnitude threshold for when the propulsion would need to shut off and reactivate. The fifth and final stage of testing will be evaluating its ability to receive telemetry and instructional data from the base station. Instructions that would be uploaded would include simple maneuvers to execute and positions to go towards.

During operations, there will be 5 modes the device can execute:

- **Landing:** the device is still attached to the drone(or crane in this case) waiting to detect a freefall condition. A freefall condition is detected when there is zero vertical acceleration followed by a hard vertical acceleration then little to none vertical acceleration.
- **Splash and dash:** If there is a preprogrammed location, then the device will drive as fast as it can to the location. While it is in transit, it will listen for a distress beacon and if detected, it will switch to search mode.
- **Search:** the device will go in a search pattern of expanding circles from the point at which the mode started searching for a distress signal. If it detects a distress signal, it will enter tracking mode.
- **Tracking**: the device will track the detected signal and drive towards it with caution. In help mode, it has a SAVER signal locked and actively tracks it while moving toward it. If it loses its lock it will continue in the direction it was heading for a set distance. If it relocks then we stay in this mode, if it loses its lock entirely it will move back into search and lock mode. The craft’s speed will use a PID control system to map the magnitude of the signal the vehicle speed. That is to say, if we get closer to the signal source we will slow down. As we get further away the craft will speed up. This is to not hit the astronaut. Once the signal is at or above a preprogrammed magnitude the craft will shut down and enter buddy mode.
- **Buddy Mode:** the device will wait until the magnitude drops below a different threshold then it will enter tracking and assist to return to the astronaut.
- **Additional features:**

    - Locations or mission profiles can be uploaded in real-time over the telemetry link.
    - If it has a telemetry link you will be able to use that to get the vehicle and SAVER signal GPS position

The following is the procedure for NBL operations:

1. Turn on the device and wait for LED confirmation that it's ready to be deployed.
2. Mount on the crane or place in the NBL according to the test plan being run.
3. Execute the test plan.
4. Recover and repeat for each test plan.

An evaluation of SAVISARR will be conducted with the testers and will include implementation requests, suggestions for improvement, ease of operation, etc. Such feedback and suggestions will be used to improve upon the design to improve effectiveness.

D. Safety

Possible hazards to occur while utilizing the device are listed below in Table 3 along with scenarios, consequences, and controls(efforts to mitigate) these hazards. Additionally, a risk assessment code(RAC) matrix(Table 2) is included in the analysis. Most preventable hazards, such as inadequate structural integrity and design, will be mitigated through numerous rounds of testing of the prototype.

Table 2: Risk Assessment Code(RAC) Matrix

		Probability				
		Unlikely	Seldom	Occasional	Likely	Frequent
Severity	Catastrophic	M	H	H	E	E
	Critical	L	M	H	H	E
	Marginal	L	L	M	M	H
	Negligible	L	L	L	L	M

*Probability - the likelihood to cause an incident, near miss, or accident
*Severity - the outcome or degree if an incident, near miss, or accident has occurred
*E = Extremely High Risk, H = High Risk, M = Moderate Risk, L = Low Risk

Table 3: Hazard Analysis Table

Hazard	Scenario	Effects	Controls	RAC
Collision	Obstacle(watercraft or person) in the path of the device. Failure for the system to control speed caused by an error in hardware. Failure for the system to control speed caused by an error in the software.	Personal injury Equipment loss/damage	Clearly mark the vehicle with high visibility labels. Multiple tests in multiple different scenarios. Failsafe in the software.	M
Unscheduled rapid possession of water	Collision with an obstacle in the device's path leading to structural damage. Breach in the device structure.	Loss of vehicle	Finite element analysis of the assembled device along with structural testing of the prototype.	M

Capsizing	Confronting waves that the device is less capable of traversing. Sharp turns and banks.	Loss or reduction of operation	Designing with the center of gravity of the device to be centered and low. Testing in capsizing scenarios to ensure the center of gravity is adequate.	M

*Any risks listed above that a control cannot mitigate is considered as an accepted risk

E. Technical References

[1] “Chapter 47: Direction Finding Antennas and Systems.” *Antenna Engineering Handbook*, by John Leonidas Volakis, McGraw Hill Education, 2019, pp. 47–1-47–34.

[2] Markgraf et. al., Steve. “SDR (Software Defined Radio) " Rtl-Sdr.” *Rtl-Sdr - Rtl-Sdr - Open Source Mobile Communications*, osmocom.org/projects/rtl-sdr/wiki/.

[3] PĂUN, Mirel, et al. “A Software-Defined Radio Approach for Direction Finding.” *U.P.B Sci. Bull.*, vol. 77, no. 4, 2015. *C*.

II. Outreach Section

A. Mission Statement

The mission of The Buckeyes of the Galaxy Project Team is to cater knowledge and spread awareness of NASA and STEM to various communities.

B. Audiences and Objectives

To accomplish our mission, we target three different populations: K-12 students, the university community, and the public. Below is Table 4 which is our plan for K-12 outreach, we separated this population into three different sections: K-5, 6-8, and 9-12. This enables us to create more applicable outreach events for specific age groups. For grades K-5, we are promoting NASA and current programs, introducing the basic engineering design process, and presenting them opportunities to interact with STEM. For grades 6-12, the plan structure is very similar to K-5 however it goes in depth into the engineering design process, NASA's current efforts like Artemis, and an explanation of SAVISARR. This outreach plan was created to be able to accommodate in-person events as well as virtual events through platforms like Zoom. The plan includes two activities: Activity 1 will be for virtual and in-person events while Activity 2 will be for purely in-person events. Additionally, we have university and beyond outreach, in Table 5, which mainly focuses on NASA developments, Micro-G NExT, and opportunities to get involved and support STEM programs.

Table 4: K-12 Student Outreach

<table>
<tr><th colspan="4">Grades K-5</th></tr>
<tr><th><u>5E Model</u></th><th colspan="3">Description</th></tr>
<tr><td>Engage</td><td>1. “We Are Going” video on NASA’s YouTube channel</td><td>2. Allows open discussion about video</td><td>3. Presentation on:
a. What is NASA? Describe past and present accomplishments
b. What is Artemis? NASA’s future efforts to go to the moon and beyond.</td></tr>
<tr><td>Explore & Explain</td><td>1. Introduce what the engineering design process is and show how engineers use it</td><td>2. Activities:

Break out into 6-7 groups for 10 minutes with presenters depending on audience size.

Activity 1:
Have them build/draw a rocket. What is needed and why do they think it's needed?

Activity 2:
Have students construct a Mars Helicopter with a paper helicopter activity. Students can test different folds or blade lengths to see what they observe.</td><td>3. Post-activity discussion
Activity 1:
What were the common ideas from each group?
What are some good ideas and why?
What could use improvement?

Bring up any missing parts and explain why NASA engineers would consider having it via the engineering design process.

Compare their observations to what is on the Saturn 5, SLS, and Crewed Falcon 9.

Activity 2:
What happens if the helicopter rotated faster? Slower?

Which way did it spin? Can we change the direction?

What would be the “best” configuration for a helicopter?</td></tr>
<tr><td>Elaborate</td><td>1. Talk about MicroG and the engineering design process in relation to our project</td><td>2. Encourage the pursuit of STEM futures and provide resources and opportunities like:
FIRST Lego League
Space Camp</td><td>3. Personal involvement in STEM and our path to where we are now. Show diverse pathways</td></tr>
<tr><td>Evaluate</td><td>1. Open the floor to any questions they may have</td><td>2. Discuss with teacher, staff, and/or host about how we did and what we could’ve done better</td><td>3. Observe student interest and participation in activity/discussion</td></tr>
</table>

Grades 6-8			
<u>5E Model</u>	**Description**		
Engage	1. “Rocket Science in 60 Seconds: What is the Space Launch System?” video on NASA’s YouTube channel	2. Allows open discussion about video	3. Presentation on: NASA Crash Course Accomplishment Artemis, what we already know and what to look towards in the future.
Explore & Explain	1. Review the design process	2. Activities: Break out into 6-7 groups for 10 minutes with presenters depending on audience size. Activity 1: Design and plan out a moon colony? Activity 2: Have students design their own balloon rocket to carry as many paperclips as they can.	3. Post-activity discussion: Activity 1: What are the most common necessities for a moon colony? What ideas need more improvement? Do any ideas need to be more elaborate? Discuss how many different aspects NASA engineers have to take into account to sustain life on another planet. Activity 2: What design really worked well and why? What are some ways to improve their rocket? Why is this important for heavy-lift rockets? Discuss aspects of rocket weights relative to power for lift off and landings.
Elaborate	1. Talk about MicroG and the engineering design process in relation to our project	2. Encourage the pursuit of STEM futures and provide resources and opportunities like: FIRST Lego League & Tech Challenge VEX Robotics Space Camp	3. Personal involvement in STEM and our path to where we are now. Show diverse pathways
Evaluate	1. Open the floor to any questions they may have	2. Discuss with teacher, staff, and/or host about how we did and what we could’ve done better.	3. Observe student interest and participation in activity/discussion

<table>
<tr><th colspan="4">Grades 9-12</th></tr>
<tr><th><u>5E Model</u></th><th colspan="3">Description</th></tr>
<tr><td>Engage</td><td>1. “How We Are Going To The Moon” video on NASA’s YouTube channel</td><td>2. Allows open discussion about video</td><td>3. Presentation on:
a. What we already know about NASA? Discuss current missions
b. What we already know about Artemis? Update on current progress</td></tr>
<tr><td>Explore & Explain</td><td>1. Review of the engineering design process</td><td>2. Activities:

Break out into 6-7 groups for 10 minutes with presenters depending on audience size.

Activity 1: Design a moon space station

Activity 2: Build bottle rockets and launch them</td><td>3. Post-activity discussion:

Activity 1:
How will astronauts live? What would they need to have? How different or similar would it be to the International Space Station?

Activity 2:
Which rocket flew the straightest and why?
If you launched the rocket on the moon, how high would it go?
How does Newton’s Second Law Apply here?</td></tr>
<tr><td>Elaborate</td><td>1. Talk about MicroG and the engineering design process in relation to our project</td><td>2. Encourage the pursuit of STEM futures and provide resources and opportunities like:
FIRST Robotics & Tech Challenge
VEX Robotics
Student Launch Initiative
Space Camp</td><td>3. Personal involvement in STEM and our path to where we are now. Show diverse pathways</td></tr>
<tr><td>Evaluate</td><td>1. Open the floor to any questions they may have</td><td>2. Discuss with teacher, staff, and host about how we did and what we could’ve done better</td><td>3. Observe student interest and participation in activity/discussion</td></tr>
</table>

Table 5: University and Beyond Outreach

Activity	Adults
Introduction	Introduce our team and our university
NASA video	"How We Are Going to the Moon" NASA video to acquire interest from the audience
NASA presentation	What is NASA doing right now? Artemis Program Commercial Crew Program International Space Station Mars 2020 Perseverance Rover And more
MicroG NExT Program Presentation	1. Introduce MicroG NExT and its goals 2. Introduce the challenge/problem we chose to solve: Develop and test a device to provide aid and supplies to an astronaut isolated from the Orion capsule's life raft in the event of a launch abort or contingency landing. 3. Present our solution and progression: a. Initial ideas and brainstorming process b. Show the current progress and any changes to the initial design due to issues we have encountered c. Demonstrate how the current version works, how we built it, budgeting for resources and materials
Ways to Help	Encourage the support of STEM by participation, funding, and mentorship through platforms such as: FIRST Lego League / Tech Challenge/ Robotics Competition /Global VEX Robotics Competition Hack-a-thons Personal involvement in STEM and our path to where we are now
Conclusion	Open the floor to any questions they may have.

C. Social Media Outreach and Press Plan

All of our outreach events and progress on the project will be documented on our social media accounts on Instagram, Twitter, and Facebook. This broad outreach allows us to effectively promote NASA and our design to a wide range of communities. Additionally, this plan includes reaching out to our campus newspaper, The Lantern, as well as the internal Ohio State College of Engineering news platform. Below is Table 6 which is a list of our social media accounts.

Table 6: Social Media Outreach

Platform	Weblink
Email	osumicrognext@gmail.com
Instagram	https://www.instagram.com/osumicrognext/
Twitter	https://twitter.com/OSUMicroG
Facebook	https://www.facebook.com/OSUMicroG

III. Administrative Section

A. Test Week Preference

The team requests the test week of June 14-19, 2021.

B. Mentor Request

The team will be requesting Tamra George from Johnson Space Center as our mentor.

C. Institutional Letter of Endorsement

See the following page.

D. Statement of Supervising Faculty

See the following page.

John M. Horack, Ph.D.

- Senior Associate Dean of Engineering
- Professor and Neil Armstrong Chair in Aerospace

College of Engineering and **John Glenn College of Public Affairs**

The Ohio State University
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43210

+1.256.665.3356
horack.1@osu.edu

October 21, 2020

Institutional Commitment and Faculty Support Letter - "Buckeyes of the Galaxy"

Dear Colleagues,

As the faculty advisor for the forthcoming NASA MicroG-NExT team experiment from Ohio State University, operating under the name "The Buckeyes of the Galaxy," I concur with the concepts and methods by which this project will be conducted. I will ensure that all reports and deadlines are completed by the student team members in a timely manner. I furthermore understand that any default by this team concerning any Program requirements (including submission of final report materials) could adversely affect selection opportunities of future teams from The Ohio State University.

My position as Senior Associate Dean of Engineering will hopefully also enable this letter to fulfill the requirement of 'institutional commitment' from a Dean, Department Chair, or other suitable member of the leadership team here within the College of Engineering at The Ohio State University.

I would be happy to answer any questions you may have, and look forward to a successful project season for NASA and all of the teams participating.

Kind regards,

John M. Horack, Ph.D.

E. Statement of Rights of Use

As a team member for a proposal entitled "Surface Autonomous Vehicle for Initial Search and Rescue Response (SAVISARR)" proposed by a team of undergraduate students from The Ohio State University, 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 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.

As a team member for a proposal entitled "Surface Autonomous Vehicle for Initial Search and Rescue Response (SAVISARR)" proposed by a team of undergraduate students from The Ohio State University, 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 an invention described or made part of this proposal throughout the world.

Signed,

Ally Batterton

Connor Beheydt

Maxwell Fojtik

Edward Lui

Lily McGee

Deepal Nadar

Matthew Zirbel

Horack, John Digitally signed by Horack, John
Date: 2020.10.21 15:29:57 -04'00'

Dr. John Horack

F. Funding and Budget Statement

Budget	
Materials and Supplies	
Materials	$2,500
Kerberos SDR	$250
Magnetic Whip Antennas (RTL2832U)	$60
3D Printing	$200
Manufacturing	$100
Misc. Team	$300
JSC	
Flight	$3,000
Shipping	$900
Transportation	$500
Food	$1,000
Hotel	$3,000
Outreach	
Transportation	$100
Materials	$100
Uniforms	$200
Total	$12,210

The team plans on obtaining funding for this project from The Ohio State University and affiliates.

G. Parental Consent Forms

Parental consent forms are not needed; all team members are over the age of 18.

Appendix A: Technical Drawings and Photos

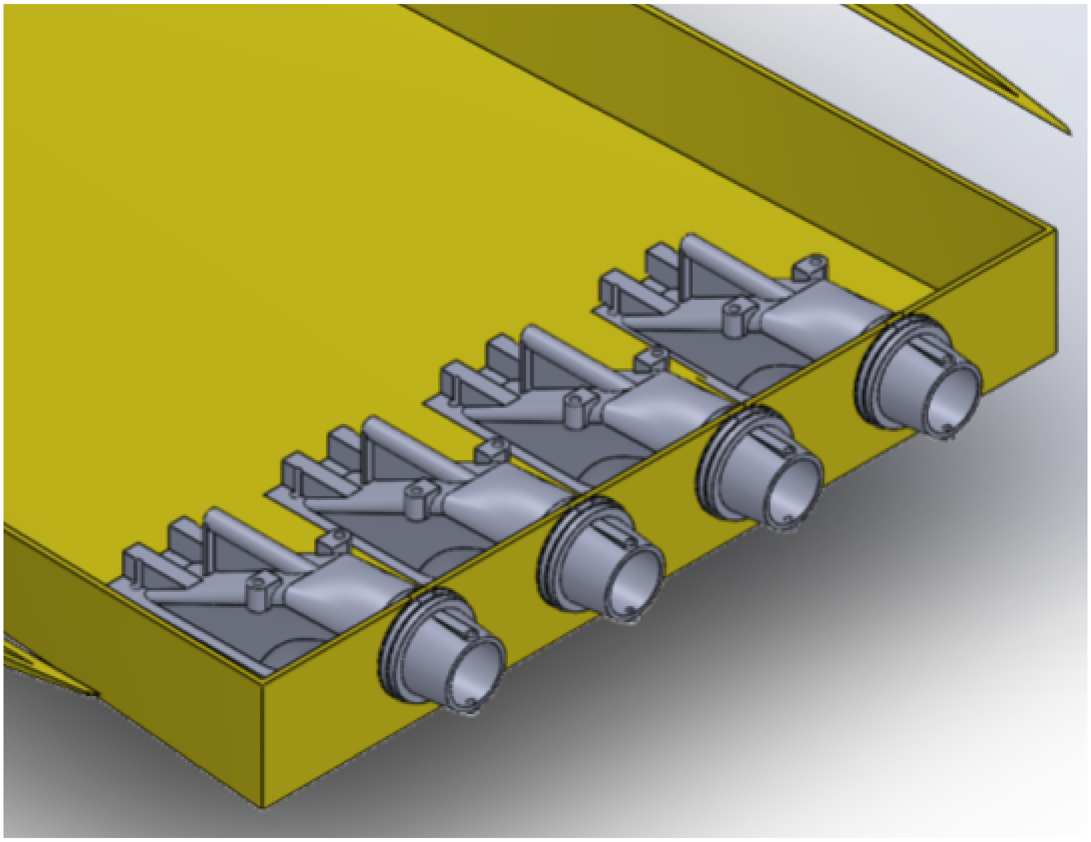

Figure 7: Jet Drive Cross Section

Appendix B: Outreach Agreement Letters

October 29, 2020

NASA MicroG-NExT Office,

This letter is a confirmation of the outreach that Ohio State's Micro-G Next team is involved in. Representatives from the team will join us at the COSI Big Science celebration and next year's Hamfest.

At both of these events they will address visitor groups of all ages. The main focus of the combined Amateur Radio Club and MicroG-NExT table is to explain how the tracking system was designed. We also expect them to share resources with visitors on how they can pursue similar projects at home.

Sincerely,

Deepal Nadar
President
Amateur Radio Club at Ohio State University

FIRST ALUMNI AND ROBOTICS AT OHIO STATE

Visit www.firstrobotics.osu.edu

NASA MicroG-NExT Office,

This letter is a confirmation of the outreach that Ohio State's Micro-G Next team is involved in. Representatives from the team will join us at our FIRST Alumni and Robotics at Ohio State Robot-in-3-Days event.

At this event, they will be interacting with coaches and high-school robotics members from all around the world and presenting their solution for the MicroG competition. This event will be fully livestreamed and posted online so that participants are still able to access this information even if they are not able to attend the event live. We are very excited to be working with OSU's MicroG team and cannot wait to hear about their creative and innovation solution.

Sincerely,

Alex Ronnebaum
President
FIRST Robotics and Alumni at Ohio State

the Electronics Club

October 25, 2020

Micro-G NExT Office and Coordinator

Lyndon B. Johnson Space Center

Houston, TX 77058

Dear Micro-G NExT Office,

After careful review of the outreach plan of The Ohio State University's Micro-G NExT Team for audiences of university students and beyond, we confirm that The Electronics Club at Ohio State will be working with the team to present, teach, and inform our audience. This is an exciting opportunity for our organization to learn more about their project regarding NASA and Micro-G NExT next semester. Please reach out to our email if you have any questions.

Sincerely,

Edward Lui

Edward Lui

President

electronicsosu@gmail.com

October 29, 2020

To Whom It May Concern;

Recently, I have had the pleasure of working with several students in the NASA Micro-G NExT Team at The Ohio State University..

During our conversations, they have mentioned doing some outreach with my middle school students, focused around engineering design, Newton’s Laws and NASA’s work. I would be happy to have them facilitate some interactive lessons with my middle school students at Grizzell Middle School in Dublin, Ohio.

While this year we have some restrictions on visitors in our buildings, we have already interacted over Zoom and would be able to facilitate the activities in this manner.

I look forward to hearing from you with more details regarding the timing for these lessons.

Sincerely,

Nicole Noteman
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