

ZER ROBOTICS

Astrobee Working Group Meeting
Nov 15th, 2023



Zero Robotics Overview

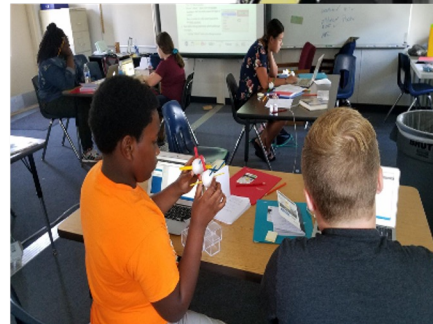


A competition

- Middle School (summer)
- High School (Fall)

A programming challenge

- Students program on space robots
- Software-based and game-specific



Zero is for **Zero Cost**

- No entry fees

Zero is for **Zero Configuration**

- Everything is programmed online

Zero is for **Zero Gravity**

- Final competition occurs aboard the ISS

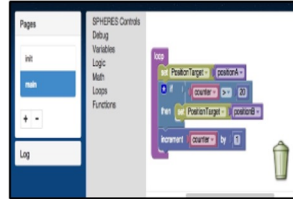
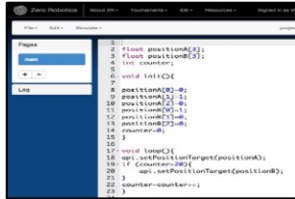


Program Implementations



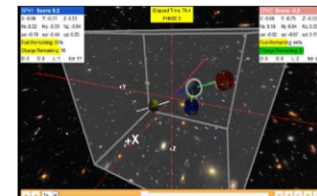
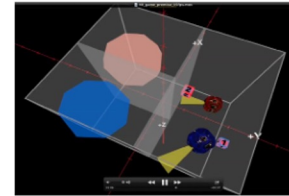
Programming Environment:

Integrated Development Environment (IDE)
Text Editor & Graphical Editor available to Students



Simulation Environment:

Students compile & simulate code online
Venue for intramural competitions



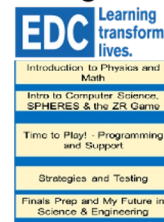
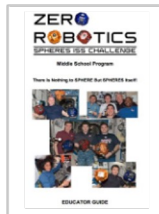
Online Mentor Resources

Online Forums, LiveTechnical Support
Tutorials, Game Documents, Outreach



Middle School Curriculum

Free Online Curriculum
5-Week Summer Program



Teacher Training

Free Training for Summer Educators
Live, web-based & hybrid trainings



2023 Zero Robotics Achievements



- 2023 UAE Zero Robotics Programming Challenge
- 2023 Zero Robotics Middle School Tournament
 - Field days at NASA, MIT
 - Final competition live-streamed
- Zero Gravity Documentary
- Plan for 2024 Zero Robotics
 - Payload status processing
 - Game design
 - Program under planning

2023 UAE ZRPC



جامعة خليفة
Khalifa University



جامعة الشارقة
UNIVERSITY OF SHARJAH

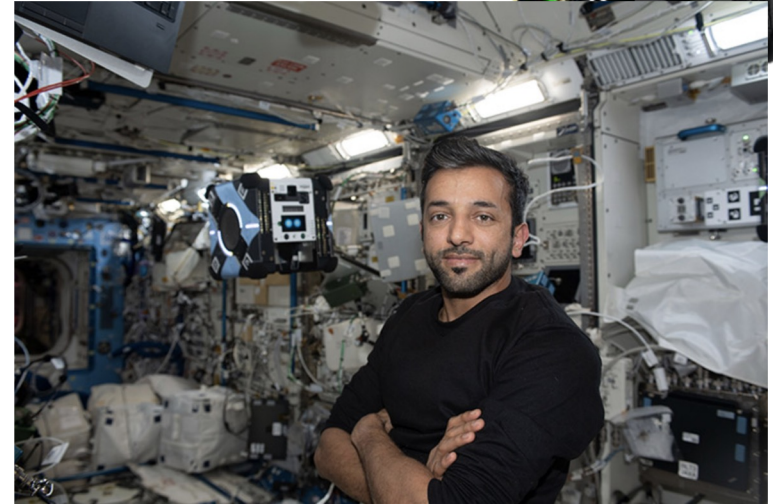


UAEU



كليات التقنية العليا
Higher Colleges of Technology

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The first UAE Zero Robotics tournament
with 7 UAE teams from 5 UAE
universities/colleges. The final competition
was live-streamed on June 23, 2023.

2023 MS “LUNABEE”



TO: Zero Robotics Teams

The Artemis program is a human Moon exploration program that aims to return to the Moon after the first human Moon presence in the Apollo 11 mission in 1969. As part of the mission, the engineering team wants to collect a set of 24 grams Lunar dust samples for analysis. They have recently introduced Astrobees, a novel free-flying autonomous robot that has the potential to recover these samples as early as the summer of 2023. Your task is, as a team, to develop a strategy to collect these samples and implement it on the Astrobees robot.

The astronauts aboard the International Space Station (ISS) have established 9 research sites on the Lunar surface, and each research site contains a collection of dust samples and a level of power left behind by previous Moon missions. However, due to power limitations, only 3 of these 9 research sites can be activated at a given time, and the activation will last for 3 minutes. The astronauts will monitor the site statuses from within the ISS and will relay which sites are active to the Astrobees robot via hand signals.

The objective of the game is to control the Astrobees robot to recognize the astronaut's hand signals, navigate to active research sites, and collect the correct number of dust samples and/or use the available power to duplicate samples such that a total of 24 grams of Lunar dust are retrieved by the Astrobees robot. The navigation and collection process must be accomplished within 3 minutes, since the sites will become inactive after 3 minutes. Time starts to count from the first Astrobees's movement, and Astrobees will stop moving and return to the base station after 3 minutes.

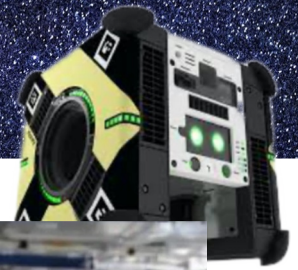
The performance of your implemented strategy will be evaluated on the total amount of Lunar dust samples Astrobees retrieved and the collection process as measured by the remaining battery level of Astrobees upon its return. Teams should read the entirety of the game manual in detail to fully understand the game rules and the performance metrics of this challenge.

Good luck to all participating space engineers!

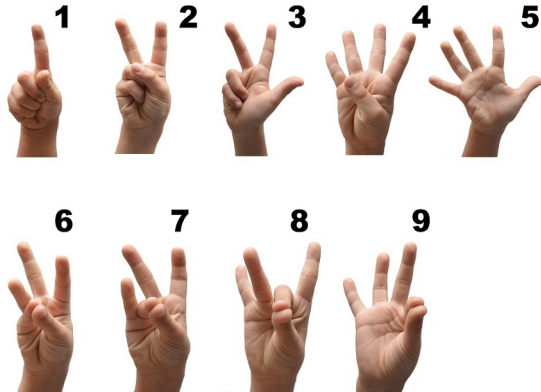
Best wishes,

Zero Robotics Lead Team

2023 MS "LUNABEE"



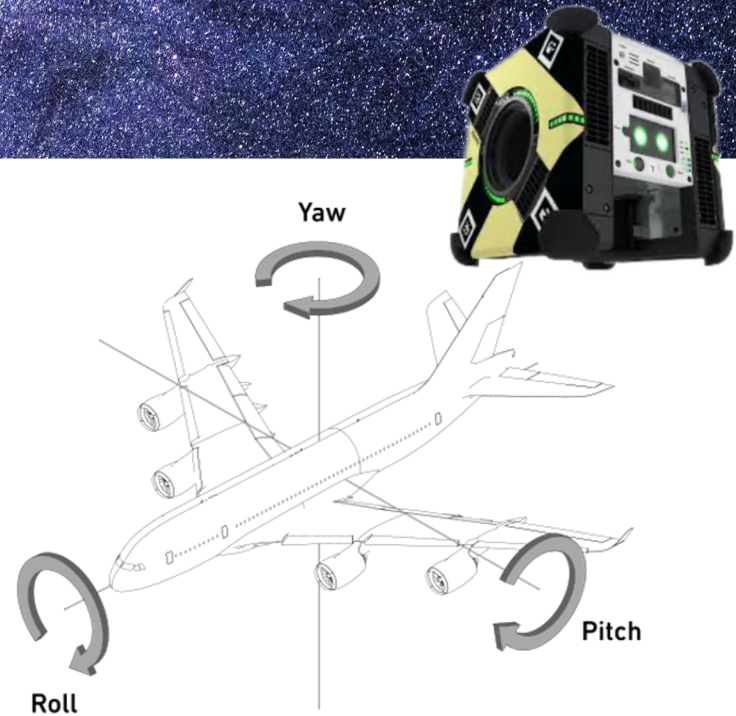
American Sign Language



Game phase 1: Control the Astrobee robots to read 3 numbers from the astronaut hand signals following ASL.

2023 MS "LUNABEE"

1	2	3
4	5	6
7	8	9



Game phase 2: Design an algorithm that can produce 24 with addition and multiplication. Then control the Astrobees robots to travel along the optimal path.

2023 MS Metrics



- 581 MS students (2022 was **178**).
- 146 educators/parents/college students trained (2022 was **67**).
- 15 states: AZ, CA, CT, IL, KS, MD, MA, MN, NJ, NM, NY, TX, VA, WV, WI (2022 was **6** states).
- 10 cross-state alliances formed in the later phase of the tournament.
- 1 US Territory: Puerto Rico (2022 was **none**).

2023 MS Field Day (NASA)



Astronaut Yvonne Cagle spoke to
ZR students.



At NASA Ames Granite Lab with
Astrobee on ground.



2023 MS Field Day (MIT)



OctoStudio Workshop at MIT Media Lab
(collaborated with Lifelong Kindergarten group).

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Students testing hand recognition
algorithms at Space Enabled.

2023 MS Final



The 2023 MS Final was hosted in hybrid on August 3rd at MIT Media Lab.

Zero Gravity



Zero Gravity is a feature documentary that follows a diverse group of middle-school students from San Jose, CA, who compete in the ZR nationwide tournament to code satellites aboard the International Space Station.

Zero Gravity is NOW available online!



54th Worldfest Houston International Film Festival -April 2021 (WINNER -Gold Award -**Best Feature Documentary**)
Only The Best International Film Awards -May 2021 (WINNER -Jury Award -**Best Feature Documentary**)
Desertscape International Film Festival -June 2021 (WINNER -**Best Feature Documentary**)

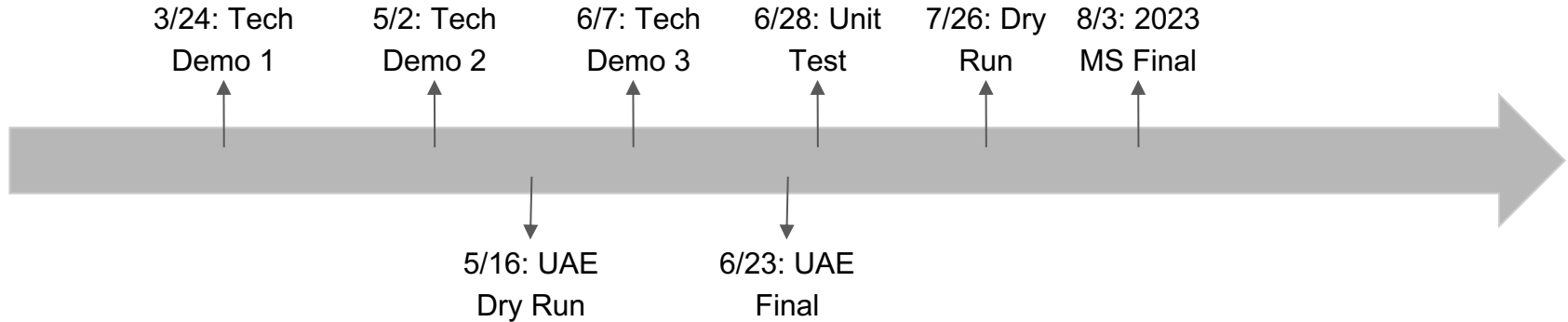
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Zero Robotics Future Plan



- Kicked off on Nov 7th, 2023 with NASA Ames and MIT.
- Extending hand sign recognition functionality to include simple commands following by the ISS hand sign language.
- 2024 game design is in process.
- Payload contract is in process.
- Defining 2024 program timelines and key milestones.

Zero Robotics 2023 ISS Ops Summary



Thank you!



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