Lunar Rescue Concept for Incapacitated EVA Crew
13 Characters

Jonah Davies, Natalia Gamez, Giovanni Trujillo, Ronald Ulloa, Jason Thom
Faculty Advisor: Dr. Kazi Rashed
San Jacinto College, Houston, TX
For more information, contact 13 Characters at 13.character@sjcdedu.onmicrosoft.com

About The Challenge

•The purpose of this challenge is to give undergraduates a chance to design an ICR (Incapacitated Crew Rescue) Craft that is light, easy to use and would only take one healthy crew to operate it.

Materials

Frame – Al-2219 allows the cart to withstand high and low temperatures and is used in other aerospace modules such as the Columbus module on the ISS.

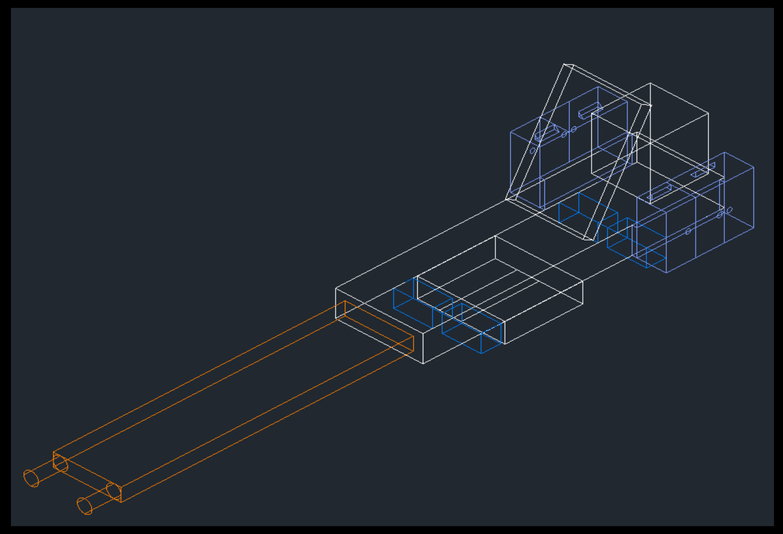
Wheels – Wired mesh treads allow the cart to sift and move through lunar regolith with ease.

Design Overview

•Our ICR concept is a four wheeled cart, including a seat for the incapacitated crew, a harness for the healthy crew to steer and pull the cart and storage containers for increased utility.

•Each wheel will have its own brake, motor and suspension. This was done for redundancy as only one set of brakes and motors need be active at once

•Our cart will have detachable storage compartments as well as a ramp and a winch for easy loading of the incapacitated crew.



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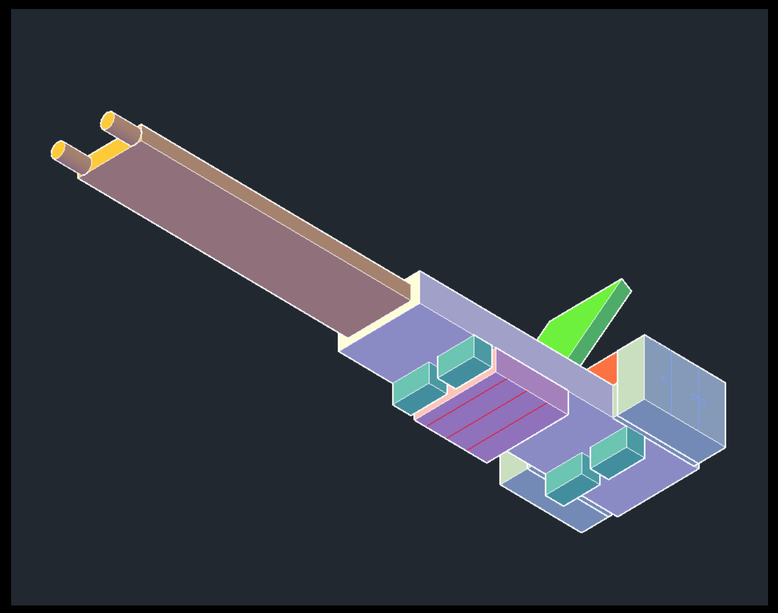

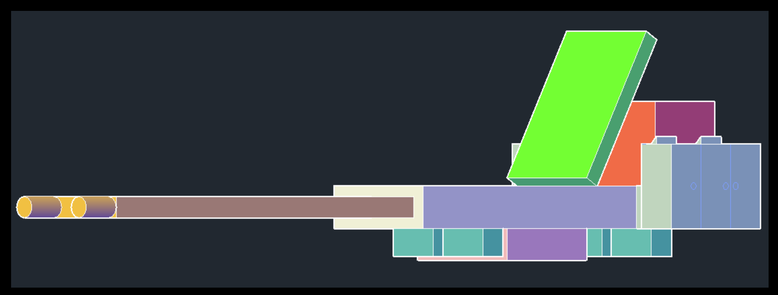

Our brakes will use a tension-based system to engage and disengage, allowing them to be operated mechanically with no electronic components. The brakes would connect to a bar at the end of the harness, at the carts front. The bar will be able to lock in place acting as a parking brake, negating the chance of it slipping away

The cart would include four detachable storage compartments, two larger in size, 12”x12”x6”, and two smaller, 6”x6”x12”. One of each will be located on either side of the cart for tool and sample storage during EVA. In the event of an emergency, the compartments can be detached to reduce the ICR's mass

Our ICR will utilize a ramp and winch system to retrieve the incapacitated crew and move them onto its frame. Once the ramp has been lowered to the ground, you can connect the winch to the incapacitated crew and lift them onto the ICR to secure them in their seat.

Conclusion

13 Characters acknowledges that some of our information may have been inaccurate. However, we’ve made the necessary improvements and have worked to demonstrate greater effort and progress.

Acknowledgement

13 Characters would like to thank the following recipients for their contribution, guidance and support in our ICR’s design development:

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Anne Vaughan

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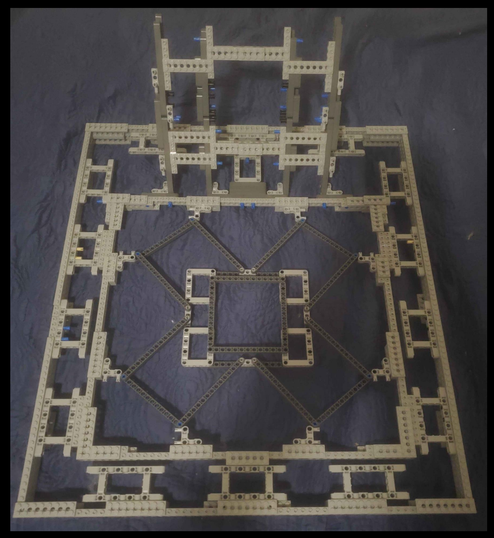

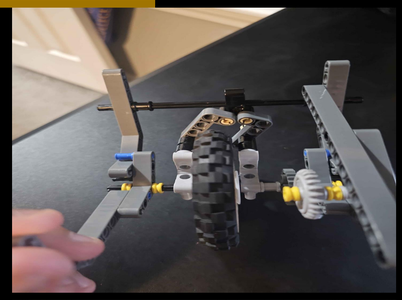

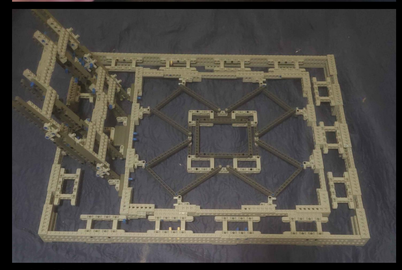

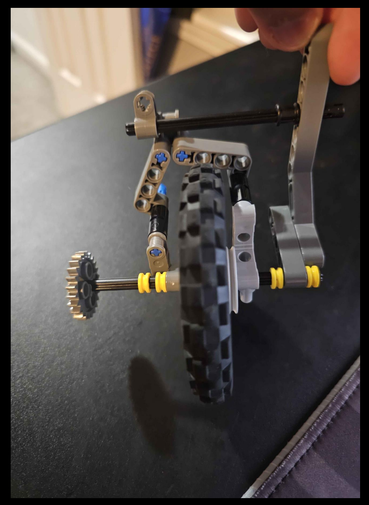

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Down Selection/Previous Designs

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Design 2
The second design's goal was to be as simple as possible and have no reliance on electrical power. It would be a two wheeled "mule cart" with a detachable ramp to assist the crew with moving the incapacitated astronaut onto the craft. On this design, there would have been a seat placed in the middle to position the crew member in a at the CG. This design was scrapped in favor of the current one due to having increased workload on the healthy crew member.

The Specifics

The Frame

The ICR's frame will be a 6'4'4" aluminum lattice with four wheels. Each wheel having its own mechanical brake; it will use a double wishbone suspension system and have two sets of differential axles to allow for easier turning. The rear wheels will have assistant motors to help initiate movement of the craft and maintain it on slopes or rough terrain. There will be a set of storage compartments for science samples and tools, so the astronauts do not have to carry them around. If a crew member is incapacitated, a ramp will be stored within the frame near the rear which can be taken out and attached to assist with lifting the incapacitated onto the frame. Once up, there will be a seat similar to those seen in military aircraft with a set of double retractor seat belts to hold them in place

The Subsystems

The Motors: The ICR will have two motors, one mounted on each rear wheel. Their sole purpose will be to assist in initiating the crafts movement and helping to maintain the movement on rough terrain or inclines so that healthy crew does not expend as much energy. Their energy will be supplied through batteries mounted near the front of the craft

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Issues and Solutions

Temperature: The temperature range given for this design challenge was from 99 to 238 Rankine. These extreme temperatures can cause significant thermal stress on components, leading to permanent warping on several components. To help counter this, we will use Aluminum 2219 and ablative materials such as a reflective coating on the outside of the craft to prevent heating through solar radiation and a thin silica lining encasing sensitive components to help keep a constant temperature, as well as vacuum sealing the components to halt heat transfer as much as possible.

Lunar Dust: The dust particulate on the Moon is as sharp as broken glass, because it literally is. Lunar dust is incredibly abrasive as well as sharp and can be dangerous to both the crew and the craft's sensitive systems. To reduce the amount of dust that ends up on the craft, the wheels will have flap guards as well as consisting of a wire mesh, and most frame parts will utilize a low friction finish to allow for the particulate to simply slide off or fall through the ICR.

Mass: Reducing mass is a crucial requirement for anything traveling upon a rocket, as increases in the rocket's dry mass can dramatically reduce Dv (Delta-v) for all stages that will need to move the additional mass. 13 Characters have mitigated this by using lightweight aluminum alloys for the bulk of the ICR and using a gridded structure to reduce the total volume of the craft.

Terrain: The Lunar surface is covered with erratic terrain formations that can be a serious challenge to traverse without pulling an ICR with an astronaut on it. To help reduce the effects of this on the pulling astronaut, 13 Characters have ensured the craft's mass will remain as low as possible and have opted to use electric motors to assist the crew with moving the ICR.

Conclusion

- 13 Characters current incapacitated crew rescue craft was selected though pugh chart analysis. We recognize that this design is not perfect and is missing decent amounts of information. If this design is accepted, we will flesh out the systems of the ICR to the best of our abilities

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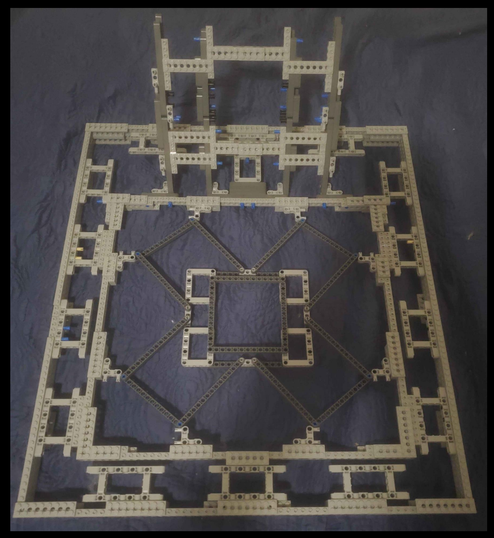

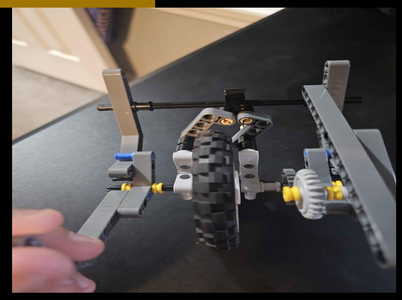

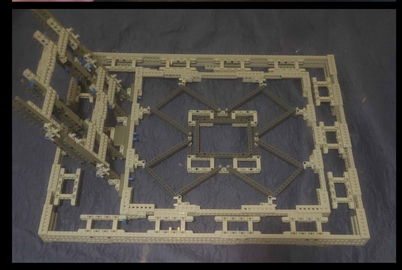

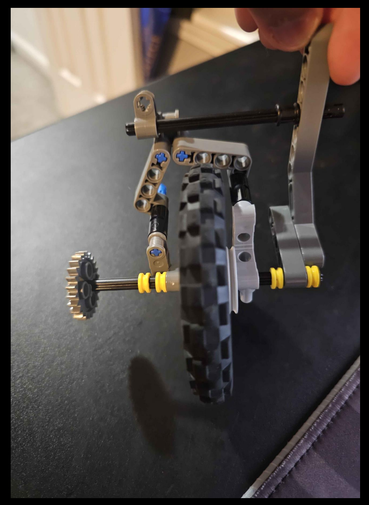

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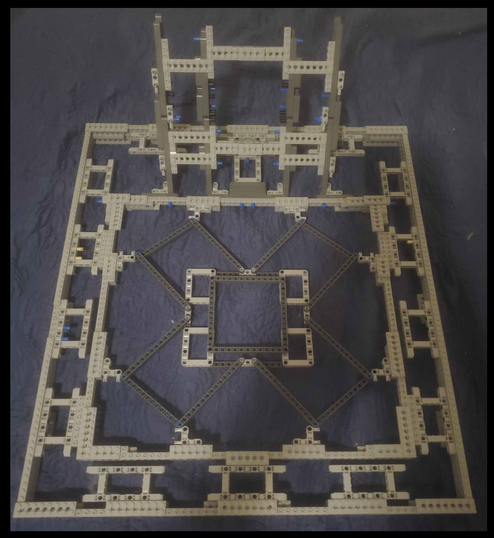

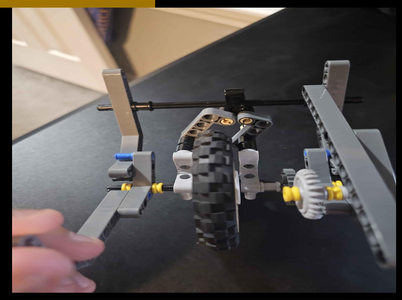

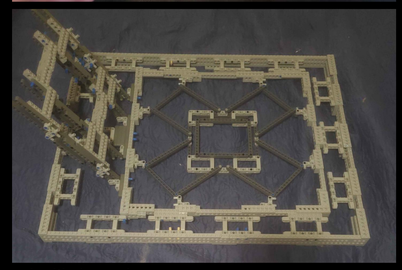

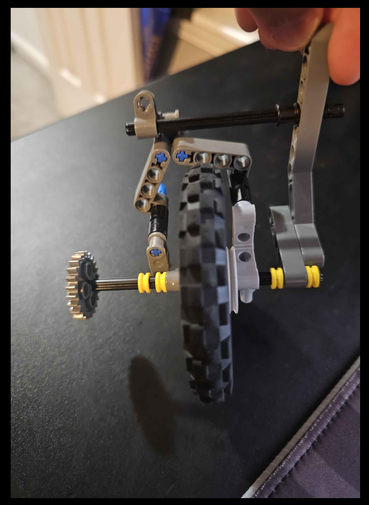

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