IGLUNA 2020
Project Show

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introduction

team structure

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Integrated Product Design

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Prof PhD Design

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**Financial, Material and Sponsors Team Leader**

**Team Leader**
Coordination team leader

**Alternate Team Leader**
Communication and first coordination responsible

**Design and Technical Team Leader**
introduction

presentation summary

why

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Astronauts’ daily lives

Design in extreme environments

Building on cooperation

Final goals

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Plan of action

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3D printing in space

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Subsystems

Archaic

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Conclusions

Q & A
Astronauts’ daily lives

first investigation

Insights

Food can still be linked to the emotional side of daily routine

Preparing the meal can be explored as a pleasurable part of space living

SOURCE: The Verge

Space Cookies with DoubleTree
Astronauts’ daily lives

Insights

Microbes are a serious concern on space exploration, and one variable that is literally part of ourselves.

Surface and tool cleaning is an essential part of space habits.

ISS microbe swab kit

SOURCE: NASA
### Austronauts’ daily lives

#### routine mapping

<table>
<thead>
<tr>
<th>Steps</th>
<th>Actions</th>
<th>Thoughts</th>
<th>Feelings</th>
<th>Opportunities of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ preparation /</td>
<td></td>
<td>Realizes is hungry</td>
<td>Is a little stressed about the thought of having to cook.</td>
<td>how the food is stored. Secondly, the set of tools with which the raw foodstuffs are transformed into ingredients ready for the cooking step. Another aspect is the cleaning of said ingredients, since this is essential for a healthy and pleasant meal. Finally, there is the work area and its related furniture, with ergonomics and versatility in mind.</td>
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<tr>
<td></td>
<td>Checks the time and sees it is the eating in interval</td>
<td>“That late already? I need to start cooking.”</td>
<td>Is curious if anything new can be cooked with the same daily ingredients.</td>
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<td></td>
<td></td>
<td>Decides on what to cook</td>
<td>“I wonder what I could cook with this.”</td>
<td>Hopes that he can cook something nice for himself.</td>
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<tr>
<td></td>
<td></td>
<td>Checks ingredients</td>
<td>“Where are the onions again?”</td>
<td>Stresses about the small space to cook in.</td>
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<tr>
<td></td>
<td></td>
<td>Separates ingredients</td>
<td>“Okay, so these are the steps that I have to follow.”</td>
<td>Is not so sure about the steps to take to make the recipe.</td>
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<tr>
<td></td>
<td></td>
<td>Checks recipe</td>
<td>“Maybe I should ask if someone wants to eat with me.”</td>
<td>Enjoys the thought of having company for his meal.</td>
</tr>
</tbody>
</table>
Astronauts’ daily lives

routine mapping

**Steps**

**Actions**

- Heats up the cooking device
- Prepares ingredients (cuts, mashes, mixes and seasons the food)
- Puts the food inside of the device
- Decides on what to cook
- Looks for plates and cutlery
- Asks if someone wants to join

**Thoughts**

- “Gotta be careful with these knives!”
- “So, where do I turn this on?”
- “Okay, I think I can put the food inside already.”
- “How long until it’s done?”
- “I think the plates are over there.”
- “Woah, it’s smelling good!”

**Feelings**

- Is cautious while cutting and preparing everything.
- Is upset about the controls of the cooking device.
- Starts to get excited about the meal he will have.
- Get annoyed by the it is taking for his meal to be ready.
- Gets anxious, trying to get everything ready to eat as soon as possible.
- Is delighted that the meal came out better than expected.

**Opportunities of each step**

As mentioned in the previous step, the tools for preparation of the ingredients could also be the same tools used during the cooking process. Such operations can include stirring, mixing, grabbing, flipping, and so on. This step also shows an unique opportunity - the transformation of ingredients into a proper meal. The most basic intervention in this topic would be work in a cooking device capable of heating, and as such preparing what is considered in Earth a home made meal.
**Astronauts’ daily lives**

**Routine mapping**

**Steps**

**/ eating /**

**Actions**

- Looks for a comfortable place to sit
- Invites companions
- Sits
- Eats using the plate and cutlery
- Makes conversation with passers-by
- Finishes eating

**Thoughts**

- “I should let the rest of the people know that the food is ready.”
- “So, where should I sit?”
- “Here is fine.”
- “I didn’t realize how hungry I was.”
- “It’s nice to have a chat with everyone.”
- “Oh boy, that’s enough.”

**Feelings**

- Wonders if anyone else wants to share the meal with him.
- Ponders which would be the place to eat.
- Is content with his usual spot.
- Feels fulfilled and nourished with what he cooked.
- Is happy to have such easy to talk to companions with him.
- Feels a little bit sleepy.

**Opportunities of each step**

The eating step is characterized by mainly low-tech object archetypes. However, such objects can induce behavior and promote mental wellbeing, mainly through the socialization of the act of eating. Another opportunity that should not be discarded is considering what is necessary to eat comfortably, which translating to objects, could vary from furniture to proper lighting and even to an specific soundscape inducive to relaxation.
Astronauts’ daily lives

routine mapping

Steps

/ cleaning /

Actions

Saves leftovers
Organizes dirty dishes
Checks if there is space to dry them
Washes the dishes
Leaves the dishes
Organizes the kitchen

Thoughts

“Nice, this should be enough for dinner”
“I actually used a lot of things to cook.”
“Is there any space, or do I need to make some?”
“In the Moon and still have to wash dishes.”
“I think they’ll dry by themselves.”
“Nice and tidy, just as I found it.”

Feelings

Is happy that what he cooked is enough for another meal.
Is annoyed by, the fact that he dirtied so many plates and appliances.
Ponders if his companions actually cleaned everything they used or not.
Is very upset about, the mundaneness of his task.
Is content that it didn’t took him that long.
Feels oddly satisfied, with his organization.

Opportunities of each step

The final step could be also considered the most mundane one. Cleaning is an essential part of any daily life, and when related to food, it becomes central for the maintenance of the routine. Here may be possible to share solutions with the preparation step of the journey, and as a result, simplify the steps or the number of artifacts necessary for each task.
design in extreme environments
main challenges

Volume and freight space
One of the most valuable resources in space missions is the freight volume available, and how small one object can be packed.

Step by step usage
Humans are constantly under stress in an extreme environment. Considering this, all non essential equipment should not need a specific instruction manual to be used.

Backup deployment
Time constraints regarding mission planning and deployment make emergency calls that were not accounted for especially difficult.

Functionality first
Function must come first. Extreme situations ask for objects where most possibilities were accounted for.
**design in extreme environments**

**main opportunities**

- **Volume and freight space**
  One of the most valuable resources in space missions is the freight volume available, and how small one object can be packed.

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- **Functionality first**
  Function must come first. Extreme situations ask for objects where most possibilities were accounted for.

- **Compact**
  Design solutions where the part to be transported is thought out to be as small as possible.

- **Intuitive**
  The solution itself teaches it how to be used, not requiring previous training.

- **Easily repairable**
  Use of backup parts that can be transported together with the main solution, and easily changed.

- **Efficient and effective**
  Every decision inside the solution has a specific purpose.
design in extreme environments
space renaissance

Investigating other space related initiatives, we can describe a new cultural Space Renaissance among contemporary society.

This can be seen as an emerging macro trend, spanning from private technology focused companies such as SpaceX, Blue Origin and Virgin Galactic, to streetwear and media consumption, such as the Heron Preston partnership with NASA in 2018.

We want to leverage this excitement to bring new ideas, contributing to the spacefaring missions and goals we believe in.
As designers, our main contribution to Igluna 2020 has always been focused on envisioning possible applications through a new perspective, selecting the ones pertinent to the program and developing them together with specialized professionals in their respective areas.

Through envisioning, it is possible to materialize futures and use them as functional references and inspirations, enhancing the reach of existing products and technologies.

**materializing new visions**

**enhancing lateral innovation of existing technologies**
Cooperation was essential for the progress of our team. As a group of purely designers, the Igluna support team gave pivotal engineering criticism, making us approach the developed subsystems with feasibility in mind.
In this context, we developed inside the Moony project, previously presented inside this same program in the past year.

Moony was thought as a modular lunar habitat to be built inside a lava tube, in such a way that it minimizes the materials needed to be brought to be constructed. The project focused on the habitat itself, and as such, we decided to populate with objects in a smaller scale.
final goals of our team
what we want to achieve

Contribute to the wellbeing of astronauts. Live, instead of survive.

Enhance the food making cycle in space, from a functional, social and health point of view.

Push lateral innovation applying existing technology to different contexts.

Communicate in a clear and effective manner how envisioning can enhance technological advancements.

Nurturing new perspectives about living in extreme environments in the close future.
P10_17_focus
plan of action
where is our target?

Inside the IGLUNA2020, one of the priorities from a living perspective has been on production of food on lunar soil.

However, the produced food usually needs to be transformed, in way or another, before being eaten, leaving a gap in the process chain.
Inside the IGLUNA2020, one of the priorities from a living perspective has been on production of food on lunar soil. However, the produced food usually needs to be transformed, in way or another, before being eaten, leaving a gap in the process chain.

Focus acts as a bridge closing this gap. A research project on how, through intuitive and functional design, it is possible to improve the astronauts daily lives.
plan of action
where is our target?

cleaning
transformon
consumption
consumption
consumption
redefining food experience in space

Subsystems overview
Cleaning and making sure all the produce doesn't pose a health hazard is a primary concern in a food production to consumption chain.

**UV Disinfection** provides a low energy consumption alternative to using valuable resources such as water and other liquids to this task.
transformation

Sugamuxi and Ma.Co, on the other hand, provide an alternative to cooking with no electricity through completely analog principles.
Finally, Ma.Co and Archaic cover the consumption process. Both subsystems provide an Earth-like alternative to astronauts, improving their mental wellbeing through familiarity and comfort.
3D printing in space
I.S.R.U. paradigm

To reduce the mass needed to be freighted, the natural course of action during the project was looking to additive manufacturing, and, more specifically, to regolith 3D printing. Focus’ projects minimize components to be transported, while designing pieces that will be printed and assembled by the astronauts.

3 main alternatives

- **Sulfur based concrete, mainly for martian exploration**
- **Powder based fusion through a high output laser device**
- **Self-propagating high temperature synthesis (SHS) processes**
Local production resources
Clay 3D printing

To simulate the tridimensional aspect of the subsystems, a sponsorship was made with 3D printing lab SuperForma.

With them, the objects were refined and tested through a clay variation. While this is not the proposed solution for manufacturing the lunar system, it is useful to test and correct deviations and possible failures that were not seen before.
Subsystems
Overview
Archaic is a tool for the production of ice cream on a lunar soil. With this tool, explorers can experience a taste of home without the need of electricity or other complex technology. This is done by exploiting the resources of the moon (cold environment, regolith, plant-based diet) and a simple design with as little number of parts as possible.
archaic
technological principle
market applications

BOSCH MUM5

Thermal isolation block
inspirations

Family knowledge

Lava tubes temperature

High feasibility

Moon diet


Expertise

Nexcare Cold Pack

Orange
archaic
main components
Ma.Co

subsystem overview

Ma.Co is a new coffee maker specifically designed to be used without any external heat sources, both on Moon and on Earth.

Ma.Co wants to establish new connections among past, future, Earth and Moon: by rediscovering ancient gestures, customs, shapes and materials - and adapting them to the new environment - it is possible to help astronauts in bringing a piece of Earth with them.
Ma.Co

technological principle

Add water

Zeoilte in wet and very hot

Zeoilte is dry and cool

Add heat
Ma.Co
market applications

BOSCH PerfectDry

Zeocooking

SOURCE: Newsfood website
SOURCE: BOSCH home
Ma.Co
main components
sugamuxi
subsystem overview

Sugamuxi is an oven that uses energy in a passive way, printed mainly in regolith, is designed to cook food by conduction and convection allowing you to prepare different dishes in a space environment.

Sugamuxi will be 3D printed in its totality in regolith (clay on Earth), its system of channels between internal and external walls allows the position of a material from volcanic origin called zeolite which with the addition of water can reach perfect temperatures for a possible preparation of food.
sugamuxi

technological principle

Add heat

Zeoite in wet and very hot

Zeoite is dry and cool

Add water

Food sauce

Food spoon
La casa de terracota, Boyaca, Colombia
Pre-colombian sculpture
Ryosuke Fukusada and Rui Pereira - FARO
Omid Sadri - PHO
Golden jewellery - Golden
Julie Boucherat - Mano Mani
Golden museum - Bogota
Golden inspiration
sugamuxi
main components
UV disinfection
subsystem overview

UV Disinfection is a system that focuses on disinfecting food and kitchen appliances through the use of ultraviolet type-C light.

This object packs the smallest footprint possible, aiming to reduce the most of space used during transportation. The simple electronic system and its polythene sheet, that will be folded during assembly, are the only components that are transported during spaceflight. Using UVC rays also ensures a low energy and no waste disinfection process.
uv disinfection

technological principle

Electromagnetic Spectrum

- X-rays
- Ultraviolet (UV)
- Visible Light
- Infrared
uv disinfection

market applications

LARQ bottle

Self sanitizing doorhandle

SOURCE: Dezeen
SOURCE: LARQ bottle
uv disinfection

inspirations
uv disinfection
volume estimation
uv disinfection
main components
• Design, in the field of space exploration, can play a complementary role in instigating innovation, insightful decision making and materializing future perspectives.

• Through the use of lateral innovation - using technological advancements that are already on the market in a field where they have not been applied yet - it is possible to challenge old industry paradigms and incremental advancements to the field.

• Space exploration is a field where astronauts are subject to extreme environmental conditions, and until now, projects have prioritize functionality above all. To reach and inspire larger audiences, it may be the time to start considering comfort, familiarity and wellbeing in the same level as functionality.
conclusion
Earth spinoffs

SOURCE: NASA
Thank you

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