
EPIC
CHALLENGE JNS

Fishbone Bullet Point Diagram

- **People**
  - Astronaut Uses Chemicals Wrong
    - Chemicals were improperly labeled
    - Could not read label because they broke/forgot glasses
    - Instructions for mixing unclear
  - Astronaut Has Wrong Tools
    - Did not ensure that they understood instructions from Earth
    - Did not select the right parts for the 3d printer
    - Base power tools are not charged
  - Bad Instructions Sent From Earth
    - Wrong files for 360° 3D-Cameras
    - Used wrong compression algorithm
    - Did not understand the problem
- **Equipment**
  - Satellite Does Not Send Correct Messages
    - Lasers on satellite are worn out
    - Satellite runs out of power
  - 3d Camera Cannot Recognize Parts
    - Has the wrong files
    - Bad lighting
    - Battery not charged
  - 3d Printer Does Not Provide Correct Parts/Tools
    - Broke from improper use
    - Printer wears out
    - Material not refilled
    - Wrong materials refilled
  - Run Out of Disinfectant
    - Too much used previously
    - Not enough provided to Mars
    - Poor storage conditions “spoiled” chemicals
- **Environment**
  - Sandstorm Blocks Communication
    - Lasers not strong enough to send/receive data
    - Atmosphere distorts signal too much

Concept-1

Optical Satellite-Using compression algorithms to share files-360° 3D-Cameras-3d printing parts and tools-Chemicals, germicides

Concept Improvement

Astronaut Uses Chemicals Wrong

IDEA
-Improved training, decrease reliance on chemicals (lower contamination, integrate disinfecting materials to parts and tools), a computer mixes the chemicals, better warning systems.

Astronaut Has Wrong Tools

IDEA
-Parts for repair are automatically sent to the printer from Earth, more hand tools, or an automated system helps with battery charging/cycling.

Bad Instructions Sent From Earth

IDEA
-Uniform data compression for all Missions (like using the metric system), redundant checks to confirm desired files are sent, redundant systems for sharing problem with Earth

Satellite Does Not Send Correct Messages

IDEA
-Add redundancy, and improve maintenance schedule

3d Camera Cannot Recognize Parts

IDEA
-Automated lighting detection and provision, AI checking system for confirming desired files, good alarming system related to recharging

3d Printer Does Not Provide Correct Parts/Tools

IDEA
-Automatic system to maintain/refill materials, maintain backup printer, establish cautious maintenance schedule, use automation to decrease human interaction.

Run Out of Disinfectant

IDEA
-Lessen reliance on chemical cleaners by integrating disinfecting materials to tools/parts, increase automation will decrease initial contamination.

Sandstorm Blocks Communication

IDEA
-Broadspectrum lasers should allow communication in a wider variety of situations, maintaining the radio wave satellites as backup.

Concept Document

Problem and Idea Title

Developing a system for solution of an unexpected issue - Optical Systems

Author

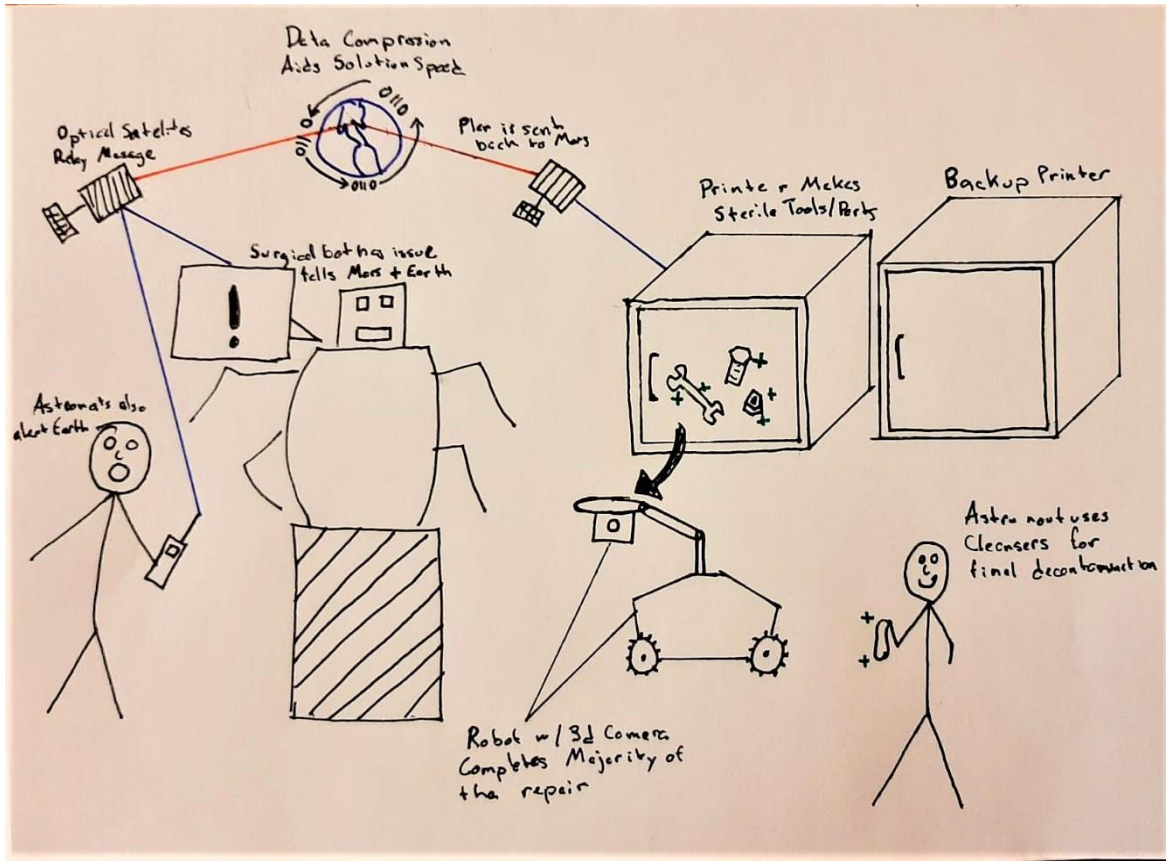
Charles Rambo, Masoud Rastgou

Description

Should there be a novel failure of the surgical robot on Mars, The initial surgical robot failure is recorded by both an automated reporting system, and warnings are relayed to the astronauts via word/symbol warnings. The problem is communicated to Earth by both the system and astronauts through a system of optical satellites which are designed with broad spectrum lasers to communicate through the atmosphere and are stationed such that the Sun nor Mars is fully in their path. Earth will use compression algorithms to allow faster communication, and larger file transfer. The instructions will be relayed back to Mars via the same satellite network. A 3d/ 360 camera will help the astronauts establish which parts are necessary. It will have a backup and extra lighting to help make sure that it is able to function. It will also aid the astronauts in establishing that the correct parts and tools have been produced by the 3d printer. The parts and tools (with a preference for hand tools) necessary for the repair will automatically be sent to the Mars based 3d printers with print materials continuously maintained by an automated system. The print materials will have antimicrobial materials added such as silver such that they will be naturally antimicrobial. Having used antimicrobial parts and tools to rebuild the surgical robot, the main concern will be chemical contamination, where possible the repairs will be handled by a robot to decrease this, and other biological robot contamination. Finally, a small amount of chemicals will be used to clean the surgical such that it is ready for use.

1.Problem is reported by astronauts, automated systems, and sent to Earth via broad spectrum optical satellites.
2.Earth uses compression algorithms to speed communication, and develop a solution.
3.A 3d/ 360 camera identifies parts.
4.3d printer creates sterile parts and tools to be used in the repair.
5.Human contact is minimized, and chemicals are used for a final disinfection.

Illustration with Keywords



PS: References for this document are in the qr code.

Fishbone Bullet Point Diagram

- **People**
  - Wrong execution
    - Bad understanding
    - Not enough knowledge
    - Wrong instructions because people on earth can't relate
    - Wrong calculations during simulations
  - Psychological issues
    - Feeling alone in Mars
    - Not being able to adapt into simulations
  - Health issues
    - Not enough medical equipment and medicine
    - Lack of healthcare/medicare person
- **Equipment**
  - Bad connection
    - Different angeles for satellite
    - Weather issues of planets
    - Video of problem cannot be send to earth
  - Broken seals
    - Doors cannot be opened and/or closed
    - “Opening doors” could lead to exposure of the whole facility
  - Barcode issues
    - Barcodes are worn out/not readable
    - wrong entry into archive
  - Hardware issues
    - Dysfunctional hardware after update
    - Worn out after hardware lifetime limit
    - Repair is impossible - total replacement
- **Environment**
  - Weather issues
    - Sandstorms on Mars
    - Weather problems on Earth (clouds, hurricane,...)
  - Resistance
    - Viruses/Bacteria develop resistance
  - Microbiological issues
    - Unknown microbiological organisms sticking to spacecraft
    - Unknown side effect of microbiological organisms

Concept-2

Video-Simulation for same situation-2d barcode alphanumeric-Xr/Vr instructions-Mars Environment

Concept Improvement

Wrong Execution	**IDEA** -Better training beforehand
Psychological issues	**IDEA** - Mental support throughout the mission -One member with psychological education
Health issues	**IDEA** -Enough medical supplies -Crew member with medicare knowledge
Bad connection	**IDEA** -Technology improvement such as 6G -Using one intermediate satellite for bridge between Earth and Mars
Broken seals	**IDEA** -High level of redundancy
Barcode issues	**IDEA** -Engraved barcodes -Two barcodes per item -Digital unique serial print for barcodes
Hardware issues	**IDEA** -Using special softwares to calculate hardware lifetime -Setting hardware usage capacity to average not maximum -More testing with the same hardware component on Earth -Producing easy repairable components
Weather issues	**IDEA** -Stronger connections -Multiple satellites, transmitters and receivers
Resistance	**IDEA** -Constant microbiological tests -Usage of multiple ways (chemicals in addition for example)
Microbiological issues	**IDEA** -Constant surveillance and check-ups

Concept Document

Problem and Idea Title

Developing a system for solution of an unexpected issue - VR Instructions

Author

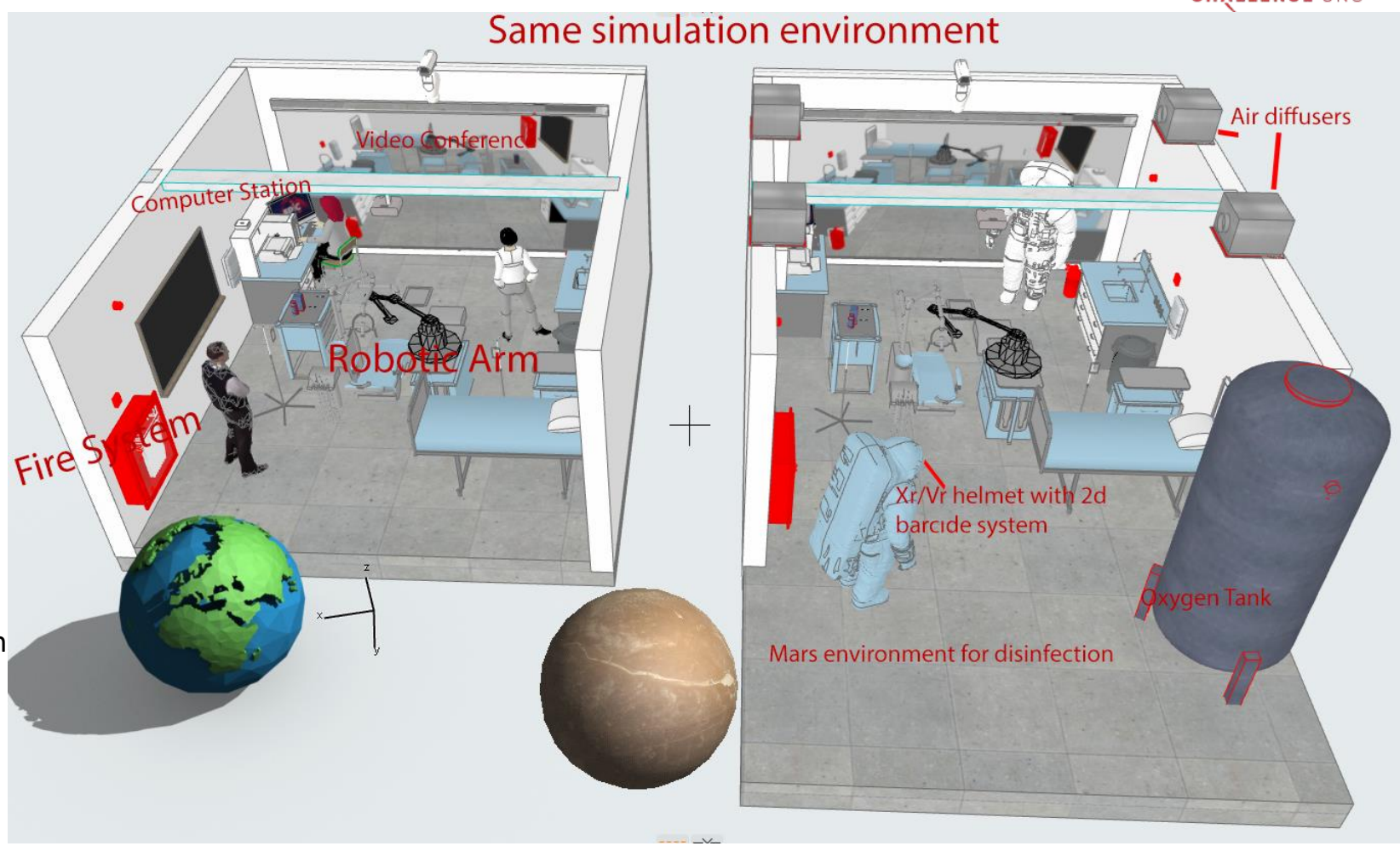
Simon Plank, Halil I. Uluoglu

Description

After sending videos of the issues that occurred after using the surgical robot system to Earth, scientists on Earth develop a strategy to repair the robotic surgery system by doing simulations on computers or with proper duplicates of the robotic system on Earth. Then they create instructions for the crew on Mars that can be viewed with VR glasses so that even persons with not sufficient knowledge can understand it. All needed parts and tools for the repair will be labeled with barcodes. To avoid mix-ups every item has two barcodes that are, if possible, engraved. To ensure a safe environment for operations the robot and the OR get disinfected by using Mars´ cold temperatures. All viruses and bacteria will be killed when in contact with the cold (-80°C even during summer).

1.Sending video about emergency robotic surgery system
2.Using simulations to develop instructions for repairing the robotic surgery system
3.Connecting to VR glasses for applying the instructions
4.2d barcode system for identifying parts and tools
5.Using Mars's conditions to disinfect the equipment

Illustration with Keywords



PS: Own 3d creation using Archicad and Photoshop programs

PS: References and work file for 3d model are in the qr code.

Fishbone Bullet Point Diagram

- **People**
  - Psychological Issues
    - Human mistakes (losing focus, impatience, misunderstanding,..)
    - Pressure (time pressure, anxiety)
  - Physical issues
    - Problems with gravitation (Earth: 9,8 m/s^2 ; Mars: 3,7 m/s^2; low gravity reduces the strength of bones and muscles)
    - High radiation exposure (2.5 times higher than in the international space station)
- **Equipment**
  - Malfunction of satellites (loss of communication during critical mission events, such as landing on Mars)
    - Overload of the DSN antenna (they track all spacecraft flying throughout our solar system)
  - Cable fire or sensor-error of the 2D cameras
    - Transmission-issues of videos and images (2D-camera)
    - ”Accidents” (dropping items on the ground)
    - For Boiling: water is rare on Mars!
    - Imprecise product from the 3D-printer (bad calibration)
    - Boiling is energy-intensive
    - Software issues on the 3D-printer
    - Climate impacts on machines (f.e. rust)
    - ”Cold problems” for machines (up to -120 degrees
    - Satellite does not send correct Messages (lasers on satellite are worn out or satellite runs out of power)
- **Environment**
  - Environment hostile to humans and machines
    - Sandstorms, lightnings, geomagnetical storms
    - Climate change (+20 to -120 degrees)
  - Distance (212.000.000 kilometers)
    - Supply
    - Communication

Concept-3

Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

Concept Improvement

Psychological Issues

IDEA
-Mental health training before, during and after by psychologists

Physical Issues

IDEA
-Targeted training for muscle and bone development before, during and after

Malfunction of Satellites

IDEA
have redundancy – if redundancy doesn´t work, have a back up satellite

Cable Fire & Transmission Issues

IDEA
-Double protection against environmental conditions (f.e. the mars surface temperature)

Climate Impact

IDEA
-Regular tests on earth under all mars conditions

Environment Hostile to Humans and Machines

IDEA
-Protective gear and equipment; simulation of sandstorms / lightnings / geomagnetical storms on earth

Symbology & Satellites

IDEA
-Maintenance of worn out satellites; NASA is working on a robot that is able to assemble parts of a spaceship in near-Earth orbit.

Supply

IDEA
-High efficient and well planned supply: material for 3D printer saves lots of space; interim storage at the moon, space lift

Communication

IDEA
-Communication base on the moon for shorter ways of communication (trying to reduce the 12 minutes spend

Concept Document

Problem and Idea Title

Developing a system for solution of an unexpected issue - Technical robotic failure

Author

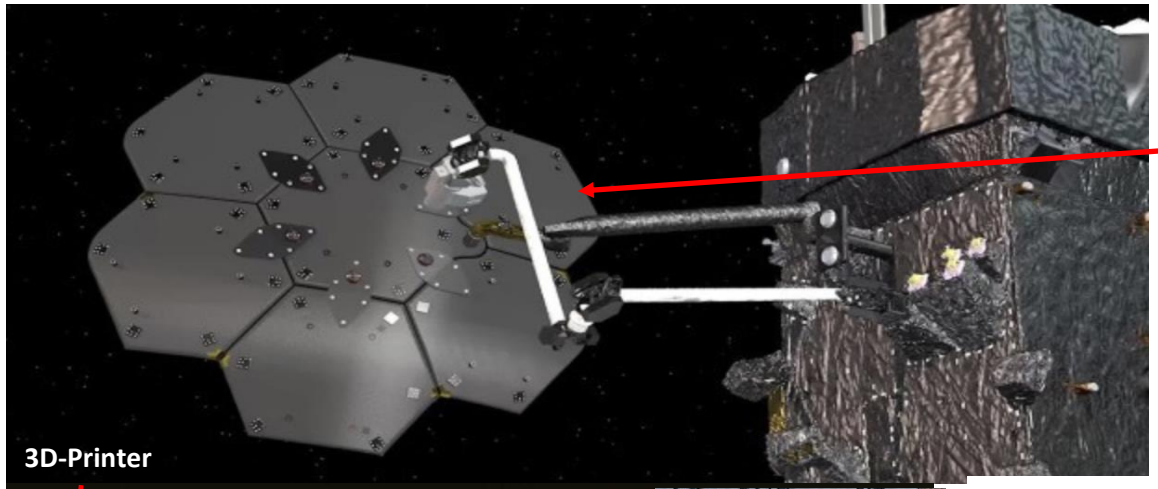
Lennart Jehle, Erik Kalmar, Lukas Mitmasser

Description

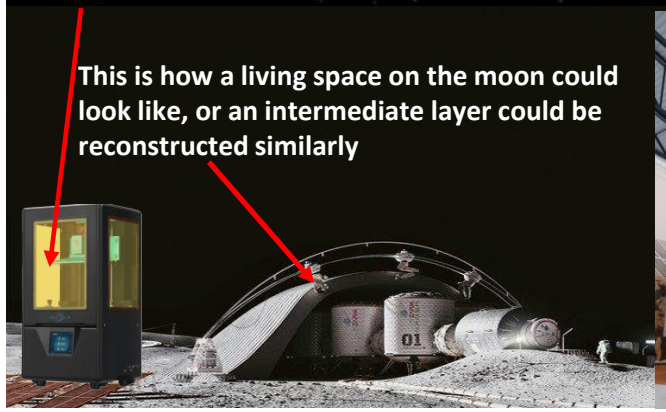
After using free-space optical communication and satellites to send the description of the technical issue to experts on earth, these scientists work together via conference call on a solution. This conference call is in constant information exchange with the astronauts. While the experts wait for a reply they already work on further steps. To identify the parts, the astronauts use 2D cameras to sense the parts and the 3D printer to produce replacement parts. All those parts are going to be disinfected by boiling water that cleans and disinfects at the same time.

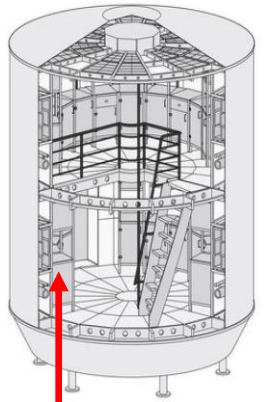
1. Using free space optical communication and satellites to communicate with experts on earth
2. Taking part in a call conference to find a solution and receive instructions
3. Using 2D cameras to sense the parts in the surgical robot
4. Parts that are defect can be replaced with identical parts what can be produced by a 3D printer
5. All the parts will be disinfected by boiling water before being used

Illustration with Keywords



This robot arm can maintain satellites or assemble structures in space.





Scientists have developed a work and living station for political relationships on the Moon and Mars. To reduce the amount of time to supply material, NASA could also build an interim storage.

First test module for a laboratory on Mars

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