Towards Perceiving the Lunar Environment

Augmented Reality (AR) – the real-time addition of information to the user's world.

Constellation Space Suit System (CSSS):

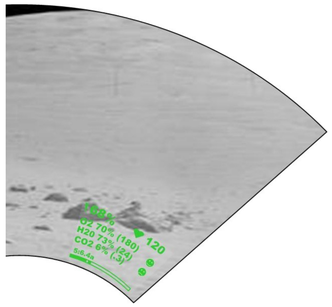
Development Goals:
•Increased physical capability, dexterity (over EMU)
•First, keep the astronaut alive; second, enable longer EVAs with improved efficiency
•Test Mars technology

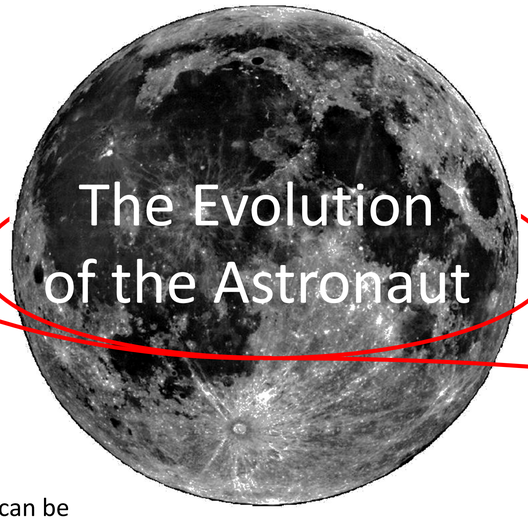
Near-term, return-to-the-Moon
Manual construction and simple science missions
GRC designing a 640x480, monochrome, helmet mounted (HMD) display
No current efforts to integrate a computer interface, interaction via radio
AR is an add-on, not life-critical
Should present Display and Control Module (DCM) data in a more convenient format

Vital Indicators

Concept: Take current Display and Control Module (DCM) data and present on the HMD in a more readable and easily seen format.

•Symbols and numbers (instead of alphanumeric)
•Indicators increase size with severity
•Resource consumption trends, project through end of the spacewalk
•DCM selector switch to call up additional information





Camera Staff

Concept: Astronauts are prevented from inspecting rocks by the suit, a staff-like magnifier with macro and wide field-of-view cameras whose feeds are synced, recorded internally, and optionally transmitted to the HMD.

•Field geology involves the dispersion *and* composition rocks
•One of the field geologist's most useful tools is a handheld magnifier
•Can be developed separately from the suit, integrated when the suit can receive and display video feeds

Perspective Radio

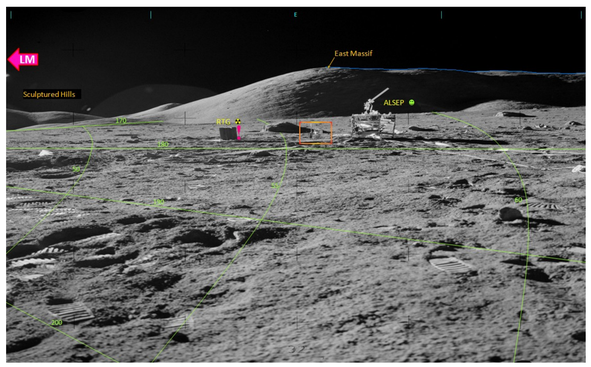
Concept: Astronauts have difficulty tracking their relative location; combine position data with the communication system, so that communications sound like they come from the speaker's actual position.

•A relatively simple application of stereo technology
•Reduces the need to check the map display
•No directly-applicable research

Mile Markers

Concept: Consistent, non-intrusive markers and symbols to improve distance perception and relative position recollection.

•Local grid origin at the Lunar Module
•'Safe house' indicated (LM arrow)
•Next task highlighted (box)
•Prominent features labeled (East Masiff)
•Dangerous/delicate equipment noted (!)
•Equipment status displayed (☺)
•Hidden features outlined (profile of the East Masiff)



Dynamic Task List

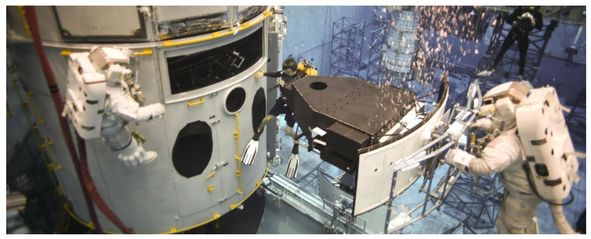
Concept: A flexible task manger that can be automatically or manually modified during the EVA.

•Astronauts will have extensively practiced small procedures common to multiple missions; once on the Moon they need only be told which procedures are required
•Similar to an astronaut's secretary, keeping them on-task, making simple, rule-based decisions for task scheduling, and providing requested, relevant, or recently updated information during the procedure
•Display mixed data (text / images / video)
•Provide varying levels of assistance (terse acronyms / descriptions / images / video of simulated procedure)
•Update with fault-finding and -resolution tasks to guide through decision tree
•Highly integrated with other suit systems
•Should query nearby devices to check if any work needs to be done
•The 'front-end' for William Clancey's mobile agents

Perspective Trading

Concept: Stream an astronaut's field-of-view and status of objects currently being used to fellow astronauts and mission control.

During STS-125, Spct. Feustel was attached to Columbia's remote manipulator and could not see around the WFC3 while inserting it. Grunsfeld positioned himself near the camera bay to guide WFC3 into place and tell Feustel when it was fully inserted. This was successful, but Feustel would have enjoyed seeing Grusfeld's perspective.



Advanced Lunar Suit:

Development Goals:
•Incorporate lessons from the return to the Moon
•Integrate fully with lunar hardware
•Reduce habitat/ground support requirement
•Enable autonomy

Advanced construction, repair, science missions
A color, full-field of view display
Computer interface approaching PC functionality
Interaction via voice, eye tracking, and other, non-traditional methods
Significant emphasis on allowing perception of the lunar environment, systems, and the interaction of these
Thorough integration of suit modules, interface and display, and near-astronaut systems

Ben Conrad | University of Wisconsin – Madison | Information Technology and Communications Directorate Intern – Mentor Priscilla Elfrey