EVALUATION OF THE NEXT-GEN EXERCISE SOFTWARE INTERFACE IN THE NEEMO ANALOG

Andrea Hanson, Ph.D.
JSC Exercise, Physiology & Countermeasures Lab

Kent Kalogera, KBRwyle, JSC Exercise, Physiology & Countermeasures Lab
Aniko Sandor, Ph.D., KBRwyle, JSC Space Human Factors and Habitability
Marc Hardy, CEO and Co-Founder of Run Social
Andrew Frank, Run Social
Kirk English, Ph.D. JES Tech, JSC Exercise, Physiology & Countermeasures Lab
Thomas Williams, Ph.D. JSC Element Scientist, Human Factors & Behavior Performance
PI-Jeevan Perera, J.D., Ph.D., JSC Software, Robotics and Simulation
Science PI- William (Bill) Amonette, Ph.D., University of Houston – Clear Lake
Background

- **NSBRI funded research grant to develop the ‘NextGen’ exercise software.**
  - Develop a software architecture to integrate instructional, motivational and socialization techniques into a common portal to enhance exercise countermeasures in remote environments.
  - Increase user efficiency and satisfaction, and institute commonality across multiple exercise systems.
  - Utilized GUI design principals focused on intuitive ease of use to minimize training time and realize early user efficiency.
  - Project requirement to test the software in an analog environment.

- **Top Level Project Aims**
  1) Improve the usability of crew interface software to exercise CMS through common app-like interfaces.
  2) Introduce virtual instructional motion training.
  3) Use virtual environment to provide remote socialization with family and friends, improve exercise technique, adherence, motivation and ultimately performance outcomes.
• The MED-2 is a small exercise device selected under the 2 x 2015 1E process to expedite fabrication and launching new International Space Station (ISS) hardware.

• The MED-2 will be used on the ISS as a test bed for understanding small exercise device capabilities and informing future Multi-Purpose Crew Vehicle exercise device designs.

• MED-2 is currently aboard the ISS.
  • First crew session planned for February 2017.
  • Valuable lessons learned from NEEMO21 evaluation provide direct benefit to ISS evaluation.
• **The NEEMO analog provides:**
  • A trained, international crew (astronauts and civilian), N=6, to carry out research objectives.
  • Mission days fashioned after ISS work plan.
  • A trained mission operations team in a functional Mission Control Room (Mission Director, Ops Lead, Schedule Lead, Capcom and use of flight-like communication tools and protocols, etc.).
  • Opportunity for work-volume assessment in a small footprint habitat.
  • A true extreme and remote test environment.
  • Dry-run of in-flight protocols and procedures.
  • Overall one of the most valuable analog and flight readiness test facilities available.
Aquarius is located ~9 miles south of Key Largo, FL at ~60 feet deep.
NEEMO21 Goals

• Evaluate NextGen SW with the MED-2 exercise device to assess user efficiency and satisfaction.
  • User satisfaction surveys post sessions.
  • Usability testing software (Morae) records each screen session and allows assessment of user efficiency.
  • Test feasibility of using the virtual interface and training partner (Run Social) with a remote user.
  • Solicit feedback on use of MED-2 hardware.
## Mission Control and NextGen Ops

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• NextGen software runs on a Microsoft Surface Pro platform.
MED Login View

[Image of NASA Miniature Exercise Device interface with user profiles and options: Overview Video, Exit]
Resistive MED View
Run Social

- RunSocial.com actual environments and socialization techniques will be evaluated as an integrated feature to the new CMS software system.

- These features will enable crew members to select daily running/rowing virtual environments with changing landscapes that match the exercise prescription provided by the astronaut strength and conditioning coaches (i.e. speed, etc).

- For NEEMO21 evaluation, upright rowing will be substituted for running, and you will be connected to a virtual training partner located topside.
  - RunSocial displayed on iPad, not the Surface Pro.
System Usability Assessment

Morae® Analysis (~20 hours of video)

- Allows you to record and remotely observe user interactions (navigation through software screen only) and audio recording for analysis of in-session commentary.

Key Feedback Captured

- Connectivity issues sometimes resulted in failure to transfer exerciser protocols, pop-up of post-session survey, and transfer of data files.
- Revealed the exercise demonstration videos were in a bad location.
- It was not clear how to navigate through the Rx list.
- The Bluetooth Heart Rate Monitor was difficult to pair.
- Server issues disrupted synchronization of data files.
- Exercise threshold settings need higher tolerance to capture all repetitions performed.
- Great crew-to-crew training and shared experience.
- Get rid of need to select start/stop at each new set.

- “This is a pretty legit workout!”
- “You have to hit end/start exercise every time and I found that very annoying.”
- “That doesn’t seem to work.” (paired with screen interaction provided flag on specific issue-selecting exercise in list vs using navigation arrows)
• **Post-Session Survey Written Feedback**
  
  • **Label cables.** Instructions were not clear in setup. Error screens and flow were not accounted for.
  
  • **Setup was cumbersome.** Once I got exercising, most things were intuitive. Not sure why I need to select stop exercise and start in between each sets that should be automatic.
  
  • **First time user with limited training, there should be pictures or video to demonstrate how to do each exercise properly with this device.** The help videos are empty and there are no images in the referenced procedure.
  
  • **If I skip an exercise, I still have to scroll past it each time I finish a subsequent exercise. The next exercise in the list should be the default.**
  
  • **Heart rate monitor is easily paired but did not display anything. No joy with a 2nd heart rate monitor.**
  
  • **The exercise prescription should follow one after the other with a 30-60 second break between sets.**
Crew Debrief & Lesson Learned

Safety Notes:
– Need to review the mechanism for emergency release of a loaded bar.
– Crew reported it was difficult to get a loaded bar in place for front squat.

Actions:
– Added caution block to ISS Procedures alerting crew to the fact that the cable will pull in if/when released.
– Demonstration and familiarity with the cable release action will be added to the ground training session.
– Crew are reminded exercise in zero-gravity is different from ground training, and to not perform any exercise they feel poses a safety concern.

GUI Notes:
– Crew provided feedback on the desire to see the software auto iterate between sets of the same exercise.

Actions:
– Videos can be sent up at any time without making changing to the flight software.
– All videos that demonstrate exercise form will be included in the ‘Exercise Review’ button, and procedures note how to find these videos.
– The button ‘Exercise Review’ will be renamed to ‘Exercise Video’ to alleviate confusion over where to locate the exercise videos.
• Additional vetting of exercise procedures in an ISS analog environment resulting in enhanced ISS MED 2 procedures.

• Redefined scheduling of hardware setup and teardown timeline. NEEMO analog environment/crew consistently showed hardware setup and teardown took longer than originally planned.

• Allow more time for operations in timeline/PlayBook (most of our sessions were not completed within allocation – set up and tear down took much longer than expected, probably help videos would have been much more useful in making the process more efficient).

• Identified shortcoming of the MED 2 heart rate monitor Bluetooth paring with the Microsoft Surface Pro 3.

• Additional training/simulation opportunity for MED 2 ISS ops and engineering support teams.

• Software development goal is to minimize training needs, through an intuitive App-like interfaces. NEEMO crew commented that the SW was intuitive and easy to use. Continue to assess how this goal has been achieved.

• Leverage video help screens vs textual/graphical help files or crew procedures (use short targeted videos) - we didn’t have enough of these videos pre-developed.

• Highlighted need for flexibility to change operational parameters and configurations, setups, questionnaires remotely (already incorporated).
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**NASA JSC MED-2 Support Team**
Stu Donnan
Austin Lovan
Henry Ong

**NEEMO Management Office**
William Todd
Marc Reagan
Jason Pofferberger
NEEMO21 Mission Control Team
FIU Aquarius Reef Basin Office

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