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Informatics Support for Decompression Sickness on Space Missions

Tyler N. Carruth, MPAS-C[a,b], M. Sriram Iyengar[a] PhD[a]

[a] *The University of Texas Health Science Center School of Health Information Sciences at Houston, Houston, Texas.*
[b] *Wyle Life Sciences, Houston, TX*

Abstract

Text-based checklists (paper and electronic) together with telecommunications links to Earth-based physicians are currently used to diagnose and treat medical conditions during space travel. GuideView, an application that augments text by presenting clinical guidelines in a structured, interactive, multi-modal format, presents clinical instructions simultaneously in voice, text, pictures video or animations. In this paper we describe a Decompression Sickness (DCS) guideline implemented in GuideView for the diagnosis and treatment during space flight

missions

Keywords:

space flight, decompression sickness, practice guidelines, multimedia

Introduction

During low earth orbit missions aboard the International Space Station (ISS) and the Space Shuttle, text-based clinical guidelines and checklists (paper and electronic) augment the assistance provided by ground-based medical support staff, including flight surgeons, to assist the crew in the diagnosis and treatment of a host of medical conditions. Astronauts can communicate with and be advised by their ground medical support via audio and/or video telecommunications links as well as downlink images for review. Due to possible telecommunication delay or loss of signal during low earth orbit missions, however, this contact with the earth-based medical support can be interrupted or intermittent. This may force the astronauts to rely on the text based procedures to navigate through complex medical tasks to respond to an emergency if one would arise.

Numerous drawbacks and limitations exist with text-based medical checklists, especially for non-physician astronaut users, whose medical experience and knowledge base may be minimal.

Through this project, we present a means of informatics support to create a "procedure assistant" using GuideView to assist in medical event response. In GuideView, procedural steps and information needed by the user to complete a task is externalized; the text is accompanied by video, audio, and images that augment the users ability to perform a task without relying on his or her memory of the system.

Guide view

GuideView technology was originally developed at NASA Johnson Space Center to provide an interactive, electronic means of guiding a user through a series of complex tasks during space exploration missions or in settings where physician availability may be low such as rural areas or remote environments. GuideView consist of two components; the GuideView Author is used to develop the guidelines in the GuideView format, and the GuideView Viewer, used to execute and display these guidelines. Guidelines developed and saved in the GuideView format are called GuideViews.

GuideViews are compatible with multiple platforms including the internet, stand-alone Windows computers, PocketPC-based PDAs, and Windows Mobile cell phones such as T-Mobile SDA and Cingular 3125. This compatibility adds to the versatility of the application in various environments.

Demonstrating GuideView

To showcase the GuideView technology, complex clinical guidelines currently used aboard the International Space Station (ISS) to evaluate Decompression Sickness (DCS) were developed using GuideView. DCS was chosen due to the complexity and number of procedures involved in the required response and treatment.

DCS, otherwise known as "the bends", is a condition astronauts may be susceptible to. In DCS, inert gas present in the bloodstream can come out of solution forming bubbles. These bubbles can embolize various tissues of the body including joints, lungs and brain causing significant pain, musculoskeletal and/or neurological impairment.

Astronauts performing space walks from the ISS may be at increased risk for this injury due to the difference in gas pressure within space suits and the interior of the Space Station[1]. When the human body is exposed to this sudden significant decrease in ambient pressure, or if a suit leak were to occur, DCS may result.

Since DCS can cause substantial impairment, response must expeditious. Because the response to such an event involves many different systems in addition to the medical component, procedures are located in multiple documents including the ISS DCS System Handbook[2,3] and the ISS Medical Checklist.[4]

Creating the DCS GuideView

In the first phase of this project, the procedures related to the recognition and treatment of DCS was reviewed by clinician subject matter advisors. These documents, developed by NASA Flight Surgeons, were used to create structured procedures that could guide an astronaut through the necessary actions of DCS treatment.

The GuideView Author, an authoring program special to this application, enabled the creation of the GuideView interface content through encoding of guideline structure and embedding of text and multi-modal content[4]. Using the GuideView Viewer, the procedural steps are presented using text, voice, still pictures, video, or animation, simultaneously.

Results

Using GuideViews, DCS guidelines were presented through a rich content delivery environment by incorporation of video and images detailing the required tasks to be preformed. Users are able to navigate through the procedure by mouse clicks directing them to the next treatment step based on information from their findings. The development of the DCS GuideView is ongoing and will involve incorporation of additional media and tangential procedures.

Voice command is a feature currently available when GuideView is run on Windows desktops and laptops and allows the user to proceed through the procedure by voice triggers such as “next” and “stop,” and “repeat last” enabling hands-free patient interaction while interacting with GuideView. This feature will be eventually incorporated into the DCS GuideView.

Conclusion

Due to telecommunication delays, real-time earth-based medical support may be difficult during long duration space missions. Text-based medical checklists have significant limitations, especially for non-physician astronauts. Instead, a more informative methodology is needed to provide informatics support such as that provided by the GuideView technology.

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