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HUMAN SPACEFLIGHT SYMPOSIUM (B3)
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HUMAN SPACEFLIGHT ROBOTIC MEDICAL FIRST RESPONDER

Abstract

The International Space Station has limited medical supplies onboard and, according to the BBC, crew members receive only 40 hours of medical training. If a medical emergency occurs, survival depends on immediate response. Other medical issues may also require urgent treatment. On the ISS, other astronauts can, aided by doctors on the ground, perform basic medical procedures. However, missions with less crew and beyond the cislunar system face even greater challenges.

SpaceX's recently announced lunar tourism trip provides an excellent example. With only two individuals onboard, an accident occurring during a collaborative activity might injure both, leaving no one to treat the wounded. Future missions might (or desire to, but be unable to) have only a single astronaut or limit teleoperation due to their distance form Earth and the associated communications delay. Whether augmenting limited training or helping a lone injured astronaut, robotic medical systems can make space travel safer – in particular for single or limited-astronaut missions.

The Robonaut 2 promises some medical capabilities, which may present a solution to this problem. It, however, is roughly human-sized, consuming valuable space in a limited capsule. In this paper, a small-size robotic medical first responder is proposed. It can be used in conjunction with the more robust capabilities of the Robonaut or alone, when space or other limitations preclude a Robonaut-size solution.

This paper focuses on the system's use to assist an astronaut during a cardiac arrest event. The system is a MIT SPHERES-inspired craft with a deployable robotic arm. It is designed to automate the process of providing emergency assistance. However, it can also be teleoperated.

An overview of the craft and its electromechanical systems and configuration is presented. Focus, then, turns to describing the software system that enables its autonomy. An expert system is used for diagnosis purposes while neural networks and template-based matching are used to identify parts of the human body from sensed imagery. The treatment expert system is used identify areas where the defibrillator pads need to be placed. The robot also detects and remove clothing in the area before deploying the defibrillator pads. Finally, the autonomous control system activates the defibrillator, senses the results of its use and takes additional corrective action, as necessary.

The system's efficacy for use onboard the ISS and other spacecraft is discussed. The paper concludes with a discussion of the benefits potentially provided to astronauts, NASA and others.