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AI PSYCHOLOGICAL SUPPORT FOR HUMAN SPACEFLIGHT

Abstract

Long duration space missions pose significant psychological and emotional challenges for astronauts due to isolation, confinement, and prolonged separation from Earth. This paper explores the feasibility of AI-powered chatbots, using Large Language Models (LLMs) and Natural Language Processing (NLP), as psychological support providers in human spaceflight. Already available technologies such as Anthropic's Claude 3.7 Sonnet, GPT-4, and Gemini can enhance conversational depth, while sentiment analysis and contextual awareness models can detect mood shifts in speech and text needed to interact with space personnel. Developments in the maturity of AI with voice recognition and speech-to-text will enable astronauts to have near human interactions. These AI models can offer coping strategies, relaxation exercises, and cognitive behavioral techniques in real time.

AI-driven mental health support systems can also adjust to individual astronaut needs, tracking psychological trends over time and identifying early signs of anxiety or depression. Current countermeasures include in-mission support in the form of teleconferences with psychologists as part of on-ground medical operations as well as care packages, coupled with the self-assessment techniques and treatments that the astronauts are trained in.

The feasibility to integrate biometric sensors (heart rate, sleep data) through API calls to enhance emotional assessments and even provide proactive support is also explored. Alongside tracking physical and psychological performance, if severe distress is detected, the system can escalate concerns to the AI and to mission psychologists.

To illustrate potential applications, we review past and ongoing implementations of AI-based mental health support in extreme environments such as Antarctic research stations and submarine crews. Drawing from these case studies, we evaluate the potential of AI-driven psychological support in future long duration missions, including lunar habitation and Mars expeditions.