Project Proposal: Mission Whisper - AI-Powered Astronaut Stress Monitoring System

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Course: ITAI 2372

- Project Track: Conceptual Design

Project Overview

Mission Whisper is an AI-powered system designed to monitor astronaut stress and emotional well-being during long-duration space missions. By analyzing voice recordings, facial expressions, biometric data (e.g., heart rate, skin temperature), and mission logs, the system detects subtle signs of stress, fatigue, or cognitive overload. It provides real-time alerts to NASA flight surgeons, mission control psychologists, and astronaut crews to mitigate risks and ensure mission success.

Problem Statement

Astronauts on extended missions face extreme psychological challenges, including isolation, high-stakes decision-making, and confined environments. Current mental health monitoring tools rely on self-reporting or periodic evaluations, which may miss subtle or masked signs of distress. Unaddressed stress can lead to communication breakdowns, reduced performance, or critical errors, jeopardizing mission safety and success.

Proposed Solution

Mission Whisper integrates multiple data streams to provide continuous, non-invasive stress monitoring:

- **Voice Analysis**: Detects emotional cues (e.g., tone, pitch) using AI models.
- **Facial Analysis**: Identifies micro-expressions via video feeds.
- **Biometric Monitoring**: Tracks physiological indicators (e.g., heart rate variability, skin temperature).
- **Text Analysis**: Analyzes mission logs or journals for sentiment and stress indicators.

The system processes these inputs through specialized AI pipelines, generates a composite risk score, and displays results on a real-time dashboard for medical staff and mission control. Alerts are triggered when stress levels exceed predefined thresholds, enabling timely interventions.

Why AI?

AI excels at identifying patterns across heterogeneous data (audio, video, text, biometrics) that humans might miss. Machine learning models, such as convolutional neural networks (CNNs) for voice and video or transformers for text, can detect subtle correlations between data types and stress states, offering a proactive approach to mental health monitoring.

Target Users

- **NASA Flight Surgeons**: Monitor crew health and recommend medical interventions.
- **Mission Control Psychologists**: Assess psychological risks and provide remote support.
- **Astronaut Crews**: Receive feedback on their well-being to self-regulate stress.

Objectives

1. Develop a comprehensive AI solution plan for stress detection using multimodal data.
2. Design a testing strategy to validate model accuracy and reliability.
3. Create a user-friendly dashboard for real-time monitoring.
4. Ensure system compatibility with space mission constraints (e.g., limited bandwidth, real-time processing).

Timeline

- **October 2024**: Research and finalize proposal.
- **November 2024**: Develop detailed solution and testing plans.
- **Early December 2024**: Compile documentation and prepare presentation.
- **December 10, 2024**: Submit via Canvas.

Deliverables

- Project proposal (this document).
- Detailed solution plan.
- Testing plan.
- Presentation slides (PDF).

Why This Matters

Mission Whisper addresses a critical gap in astronaut mental health monitoring, enhancing safety and performance on long-duration missions, such as those to Mars or lunar outposts. By leveraging AI, it provides a scalable, proactive solution for future space exploration.