AI Satellite Health Monitoring System

Team NebriX

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Abstract

The AI Satellite Health Monitoring System (AIS-HMS) is designed to autonomously assess, predict, and communicate satellite health status using AI and telemetry data. It integrates inter-satellite communication capabilities to promote real-time coordination, collision avoidance, and sustainable orbital management.

Introduction

With increasing satellite deployments, the risk of collisions, data fragmentation, and uncoordinated operations has grown. Our project introduces a unified AI-driven monitoring and communication system that enhances situational awareness and operational reliability among satellites.

Objective

To develop an AI-integrated satellite monitoring framework that ensures data security, enables efficient communication among satellites, and provides real-time health insights for global space management.

Section 1: Data Confidentiality Framework

Space agencies across the globe maintain strict data-sharing policies due to national security concerns. Our framework proposes the Global Space Data Sharing Protocol (GSDSP), a secure communication standard to promote transparent yet protected data exchange between agencies like ISRO, NASA, and ESA.

This protocol utilizes cryptographic verification, decentralized access control, and AI-assisted data anonymization. To establish this legally, international collaboration through organizations such as the UN Committee on the Peaceful Uses of Outer Space (COPUOS) and the International Telecommunication Union (ITU) will be sought. A treaty proposal will be drafted and reviewed by respective national authorities before adoption.

Section 2: Inter-Satellite Communication Network

The system enables satellites to communicate with one another using AI-optimized routing algorithms. Each satellite shares essential telemetry — such as speed, position, and orientation — with nearby satellites to maintain safe distances and optimize energy use.

This inter-satellite communication can extend beyond space applications, inspiring terrestrial networks such as autonomous vehicles to exchange environmental and positional data in real-time.

Methodology

1. Data Collection: Acquire telemetry and health data from multi-agency satellites. 2. AI Analysis: Use machine learning to detect anomalies and forecast failures. 3. Communication Layer: Enable satellites to exchange predictive alerts and navigation data. 4. Visualization: Present health analytics and communication events through the AI dashboard.

Government Collaboration & Legal Framework

The system aligns with existing international treaties like the 1967 Outer Space Treaty, ensuring transparency, peaceful cooperation, and liability sharing. Implementation will involve submitting technical white papers to COPUOS and engaging ISRO, NASA, and ESA for data-sharing agreements.

Expected Outcomes

• Enhanced inter-agency cooperation with secure data channels. • Reduction in orbital debris and collision risks. • AI-driven predictive health management. • Foundation for AI-assisted autonomous communication systems on Earth and in space.

Conclusion

The AI Satellite Health Monitoring System demonstrates the potential of AI and international cooperation in building a safer, smarter, and more sustainable space environment. By addressing data confidentiality challenges and fostering inter-satellite communication, this initiative sets the groundwork for the future of autonomous space operations.