AI-Powered Digital Twin Prototype for Satellite Health Monitoring

📅 **Start Date: 21st February 2025**
📅 **Final Deadline: 6th March 2025** (14 Days)

📌 Task Overview:

This task involves developing a **prototype** of an **AI-powered digital twin** for **satellite health monitoring**. The digital twin will **simulate real-time satellite conditions** and predict potential issues using AI models trained on simulated satellite telemetry data.

🔹 Scope of the Prototype:

1. **Digital Twin Representation of a Satellite** – Simulate **telemetry data** (temperature, battery status, radiation exposure, thruster status, etc.).
2. **AI Model for Health Monitoring & Anomaly Detection** – Use **machine learning models** to predict failures based on telemetry trends.
3. **Real-Time Dashboard** – A simple UI to visualize **satellite health status & alerts**.
4. **Cloud Deployment for Demonstration** – Host the prototype on a **free-tier cloud service** for easy access.

🚀 Deliverables & Deadlines

Phase	Task Details	Deadline
Phase 1: Data Collection & Digital Twin Setup	🔹 Identify key satellite parameters to simulate (e.g., battery voltage, solar panel efficiency, thruster health, etc.).	**23rd Feb 2025**
	🔹 Generate or use **pre-existing satellite telemetry datasets** for training & simulation.	**23rd Feb 2025**
	🔹 Set up a basic **database** (PostgreSQL/MySQL) to store simulated satellite data.	**23rd Feb 2025**
Phase 2: AI Model Development	🔹 Train an **anomaly detection model** (Isolation Forest, LSTMs, Autoencoders) using historical telemetry data.	**27th Feb 2025**
	🔹 Test AI predictions against **simulated satellite failures**.	**27th Feb 2025**

Phase 3: Real-Time Dashboard & Alerts	🔹 Create an **API to fetch live telemetry data & pass it to the AI model**.	**1st Mar 2025**
	🔹 Develop a **dashboard (Streamlit/Flask/React.js)** to visualize satellite status.	**1st Mar 2025**
	🔹 Implement an **alert system** (email/webhook) for detecting critical failures.	**1st Mar 2025**
Phase 4: Deployment & Documentation	🔹 Deploy the digital twin prototype on **free-tier cloud hosting (Render/Supabase/Vercel)**.	**6th Mar 2025**
	🔹 Write **setup documentation & AI model explanation**.	**6th Mar 2025**
	🔹 Conduct **final testing & bug fixes**.	**6th Mar 2025**

🛠️ Suggested Tech Stack:

- **Database:** PostgreSQL / MySQL (Supabase, Render)
- **AI Model:** Anomaly detection (Isolation Forest, Autoencoders, or LSTMs)
- **Backend:** Python (Flask/FastAPI)
- **Frontend:** Streamlit / React.js
- **Deployment:** Render, Vercel, GitHub Pages (free-tier)

📢 Important Notes:

✅ This is a **prototype**, so focus on **functionality over accuracy**.
✅ **No real-time satellite connection needed** – use simulated telemetry data.
✅ **Use free-tier cloud tools** for database & deployment.
✅ Ensure **dashboard displays clear health metrics & anomalies**.
✅ Submit **all code, documentation, and deployment links by 6th March 2025**.

📌 Final Submission (6th March 2025) Must Include:

✅ **Digital Twin with simulated telemetry data**
✅ **AI-powered anomaly detection model**
✅ **Real-time health monitoring dashboard**
✅ **Source code repository (GitHub/GitLab)**
✅ **Installation & usage guide**