AI-POWERED GEOSPATIAL MONITORING SYSTEM

Real-Time Environmental Threat Detection

Using Satellite AI & Cloud-Native Architecture

TEAM CODEWEAVERS

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Backend Architecture & Geospatial Systems

THE PROBLEM

Environmental Destruction Going Undetected

Traditional monitoring systems fail to detect:

- Illegal deforestation and land encroachment
- Unauthorized mining operations (coal, sand)
- Industrial water pollution and diversion
- Natural disasters (landslides, volcanic activity)

OUR SOLUTION

Cloud-Native AI Sentinel System

Real-time satellite monitoring powered by AI to detect and alert environmental threats within minutes, not months.

Satellite Integration

Sentinel-2 cloud-native data

Real-Time Alerts

Instant threat notifications

3D Visualization

Interactive globe interface

SYSTEM ARCHITECTURE

FRONTEND LAYER

React.js, Leafmap, CesiumJS, Three.js

Interactive 2D/3D visualization with real-time globe rendering

BACKEND LAYER

Java (Spring), Python, Node.js

Data processing, AI analysis, and API orchestration

DATA LAYER

Sentinel-2 Satellite, Cloud Storage

Multispectral imagery and temporal analysis pipeline

KEY TECHNOLOGIES

Geospatial

- Leafmap
- Sentinel-2 API
- GeoTIFF Processing

Visualization

- Three.js 3D Engine
- Leaflet.js Maps
- React Components
- Real-time Rendering

Backend

- Java Spring Boot
- Python AI Models
- Web Audio API
- RESTful Services

AI & Detection

- NDVI Analysis
- Temporal Comparison
- Change Detection
- Pattern Recognition

DETECTION CAPABILITIES

Deforestation

Method: **NDVI Analysis**

94%

Illegal Mining

Method: **Thermal + Texture**

91%

Water Pollution

Method: **Spectral Signature**

89%

Landslides

Method: **SAR Movement**

87%

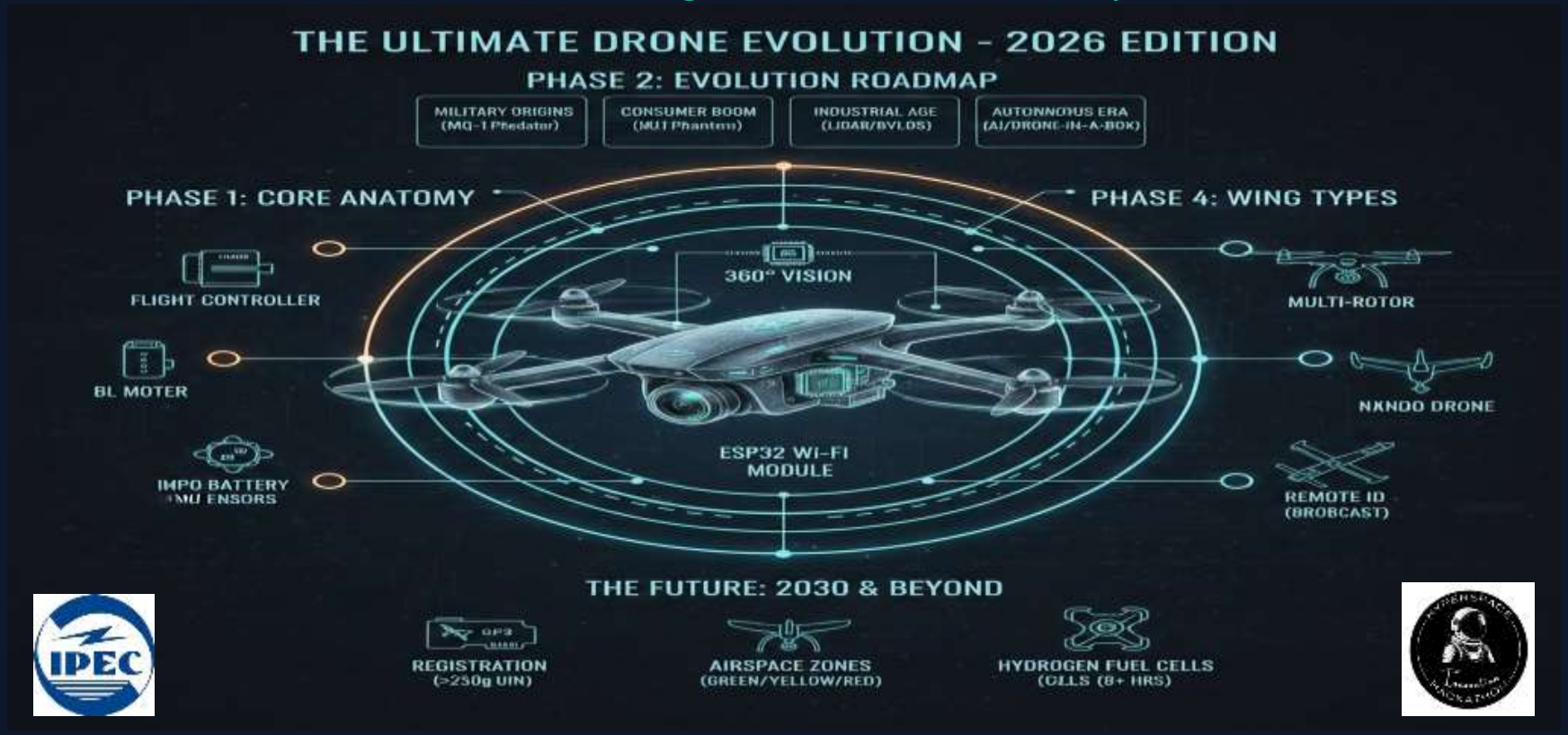
2D INTERACTIVE MAP INTERFACE

Features:

- Real-time satellite layer switching (Hybrid, Terrain, Satellite)
- Split-screen before/after comparison slider
- Geocoding search for any location globally
- Visual markers for detected threats with popup details

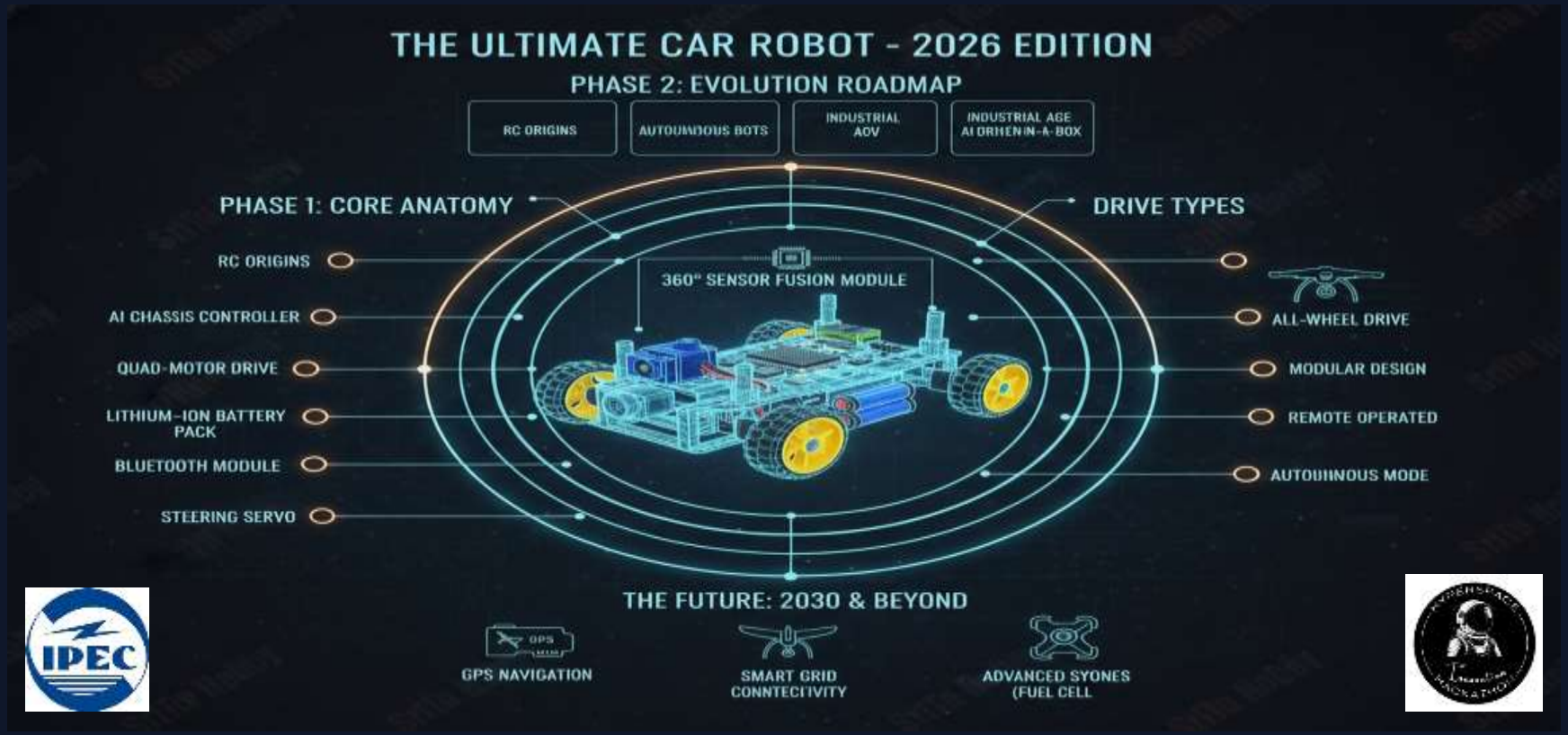
DRONE SURVEILLANCE INTEGRATION

Enhanced Monitoring with Autonomous Aerial Systems



GROUND ROBOT DEPLOYMENT

Autonomous Ground Vehicles for Remote Terrain Analysis



3D GLOBAL SENTINEL

Powered by CesiumJS

- Interactive 3D Earth rendering with real terrain data
- Fly-to animations for detected threat locations
- Real-time camera controls and orbital view
- Marker overlays with threat classification

REAL-TIME ALERT ENGINE

1. **AI Detection** — Satellite data analyzed every 5 seconds
2. **Threshold Check** — Change exceeds predefined sensitivity levels
3. **Visual Alert** — Red banner with location and threat details
4. **Audio Siren** — Web Audio API emergency tone
5. **Authority Dispatch** — Notification to enforcement teams

DEFENSE & MILITARY APPLICATIONS

Border Surveillance

- ✓ Real-time monitoring of international borders
- ✓ Unauthorized crossing detection using AI
- ✓ Integration with drone surveillance networks
- ✓ Terrain change analysis near sensitive zones

Strategic Asset Protection

- ✓ Military base perimeter monitoring
- ✓ Early warning system for encroachments
- ✓ Infrastructure threat detection (bridges, dams)
- ✓ Environmental attack identification

REAL-WORLD APPLICATIONS

Government Agencies

- Forest Department monitoring
- Mining regulation enforcement
- Water resource management
- Environmental protection

Disaster Management

- Landslide early warning
- Flood risk assessment
- Volcanic activity monitoring
- Evacuation planning

PROJECT IMPACT

4	15+	<5s	90%+
Detection Modules	Technologies Used	Alert Response Time	Detection Accuracy

Key Achievements:

- Fully functional cloud-native architecture
- Real-time 3D globe with satellite data integration
- Multi-modal alert system (visual + audio)
- Mobile-responsive field officer interface

THANK YOU

Team CodeWeavers

Archita Mukherjee • Arpan Chakraborty

"Protecting Earth, One Pixel at a Time"

Questions? We're ready to demonstrate!