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TECHNOLOGY

AL-EBPL STRUCTURAL HEALTH MONITORING

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Phase 5: Project Demonstration & Documentation

Title: AI-EBPL - Structural Health Monitoring

Abstract

The AI-EBPL Structural Health Monitoring project focuses on ensuring the safety and longevity of infrastructures using Artificial Intelligence and Embedded Predictive Learning. This system gathers real-time data from embedded sensors in critical infrastructure like bridges, buildings, and dams. The data is analyzed using machine learning algorithms to predict and detect structural anomalies. The project integrates sensor networks, AI models, and alert systems. This document outlines the project demonstration, architecture, performance metrics, testing, and future enhancements, alongside code samples and visual diagrams.

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1. Project Demonstration

Overview:

The Structural Health Monitoring system will be demonstrated in action, displaying real-time data acquisition, anomaly detection, and predictive analysis.

Demonstration Details:

System Walkthrough: From sensor data collection to AI-based decision-making.

Sensor Data: Real-time inputs from vibration, strain, and tilt sensors.

Predictive Alerts: Demonstration of AI detecting early signs of structural stress or failure.

Visualization: Real-time dashboard showcasing stress points and predictions.

Performance Metrics: Data processing speed, anomaly detection accuracy, and prediction lead-time.

Outcome:

Stakeholders will see how real-time AI predictions ensure structural safety and maintenance planning.

2. Project Documentation

Overview:

This section contains detailed documentation for system architecture, code modules, and operating guidelines.

Documentation Sections:

System Architecture: Diagrams showing sensor nodes, processing units, and cloud/server integration.

Code Documentation: AI models for prediction, embedded firmware logic, and dashboard components.

User Guide: Instructions for setup, monitoring, and alert interpretation.

Administrator Guide: Maintenance protocols, calibration steps, and data logging access.

Testing Reports: Evaluations under simulated stress, long-duration monitoring, and AI prediction benchmarks.

Outcome:

A complete package for understanding, deploying, and improving the structural monitoring system.

3. Feedback and Final Adjustments

Overview:

Post-demonstration feedback will help refine the system before final deployment.

Steps:

Feedback Collection: From mentors, civil engineers, and tech experts.

Refinement: Tuning model accuracy, improving sensor placements, and fixing UI/UX issues.

Final Testing: Revalidation of the full system across different infrastructure types.

Outcome:

An optimized, validated system prepared for deployment in real-world conditions.

4. Final Project Report Submission

Overview:

Comprehensive final report covering development, deployment, and performance.

Report Sections:

Executive Summary: Overview of objectives, design, and results.

Phase Breakdown: Data acquisition, ML model training, embedded design, dashboard implementation.

Challenges & Solutions: Noise filtering, sensor reliability, alert thresholds.

Outcomes: Reliable prediction and early-warning capabilities.

Outcome:

A formal report documenting all stages and deliverables of the project.

5. Project Handover and Future Works

Overview:

Handover of system and future roadmap.

Handover Details:

Next Steps: Scaling to city-wide infrastructure, using AI for material fatigue analysis, and wireless sensor networks.

Outcome:

System ready for field deployment and further research applications.