Phase 3: Implementation of Project

Title: AI-EBPL-Structural Health Monitoring

Objective

The goal of Phase 3 is to implement the core components of the AI-EBPL-Structural Health Monitoring system. This includes developing an AI model for structural damage detection, integrating sensor data from IoT devices, setting up a dashboard interface, and applying foundational data security protocols.

1. AI Model Development

Overview:

The AI model focuses on identifying early signs of structural stress and damage using sensor data.

Implementation:

- Machine Learning models trained on vibration, strain, and displacement datasets.
- Supervised learning with labeled structural health data.

Outcome:

The AI will classify risk levels and suggest maintenance or inspection when anomalies are detected.

2. Dashboard Interface Development

Overview:

A web-based dashboard will be developed to present real-time data and AI-generated alerts to engineers.

Implementation:

- Visualizations of stress/strain values from sensors.
- Real-time notifications for structural anomalies.

Outcome:

An operational dashboard displaying structural health metrics and recommendations.

3. IoT Device Integration

Overview:

Sensors such as accelerometers, strain gauges, and displacement sensors will be connected.

Implementation:

- Data acquisition via MQTT/HTTP protocols.
- Use of Raspberry Pi/Edge devices for data collection.

Outcome:

Live sensor feeds integrated into the system for real-time monitoring.

4. Data Security Implementation

Overview:

Basic security protocols will be implemented to protect sensor data and system access.

Implementation:

- Use of encrypted communication channels (SSL/TLS).
- Secure user authentication for dashboard access.

Outcome:

Secure handling and storage of structural health data.

5. Testing and Feedback Collection

Overview:

Initial testing in controlled environments like lab mock-ups or selected buildings.

Implementation:

- Testing with simulated structural stress.
- Feedback from civil engineers and system users.

Outcome:

Validation of AI accuracy and user interface effectiveness.

Challenges and Solutions

1. Sensor Accuracy

   Challenge: Noise or inaccuracies in sensor data.

   Solution: Filtering algorithms and sensor calibration.

2. Model Generalization

   Challenge: Model may not generalize to all building types.

   Solution: Expand dataset with diverse structures.

3. Real-time Processing

   Challenge: Latency in data handling.

   Solution: Optimize data pipelines and use edge computing.

Outcomes of Phase 3

1. Functional AI model for structural monitoring.
2. Real-time dashboard with sensor visualizations.
3. Basic IoT integration for structural data.
4. Secure data storage and communication.
5. Feedback-informed system improvements.

Next Steps for Phase 4

1. Deploy system in more real-world scenarios.
2. Improve model accuracy with broader datasets.
3. Enhance dashboard with predictive analytics and alerts.