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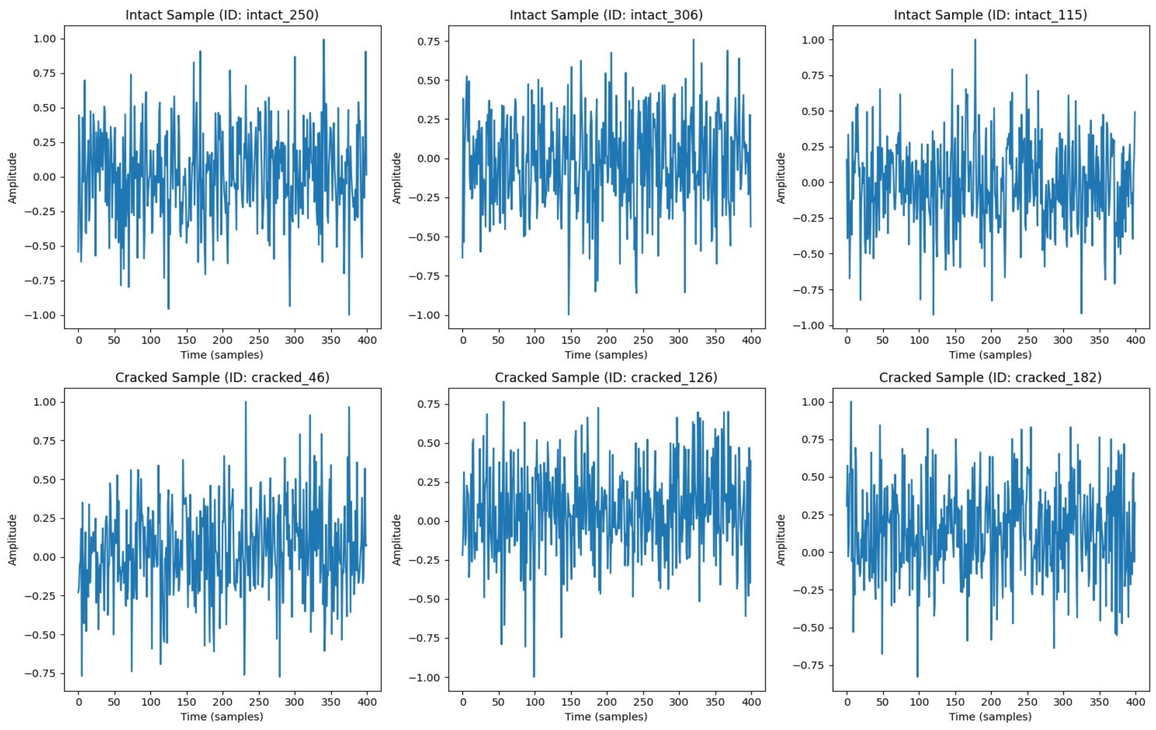
#Structural Health Monitoring System

Objective : To develop a low-cost, portable system for detecting internal cracks in metallic structures using piezoelectric discs and an ESP32/STM32 microcontroller. The system will analyze amplitude drops and phase shifts in received vibrations, leveraging FFT for real-time crack identification and structural integrity assessment. .



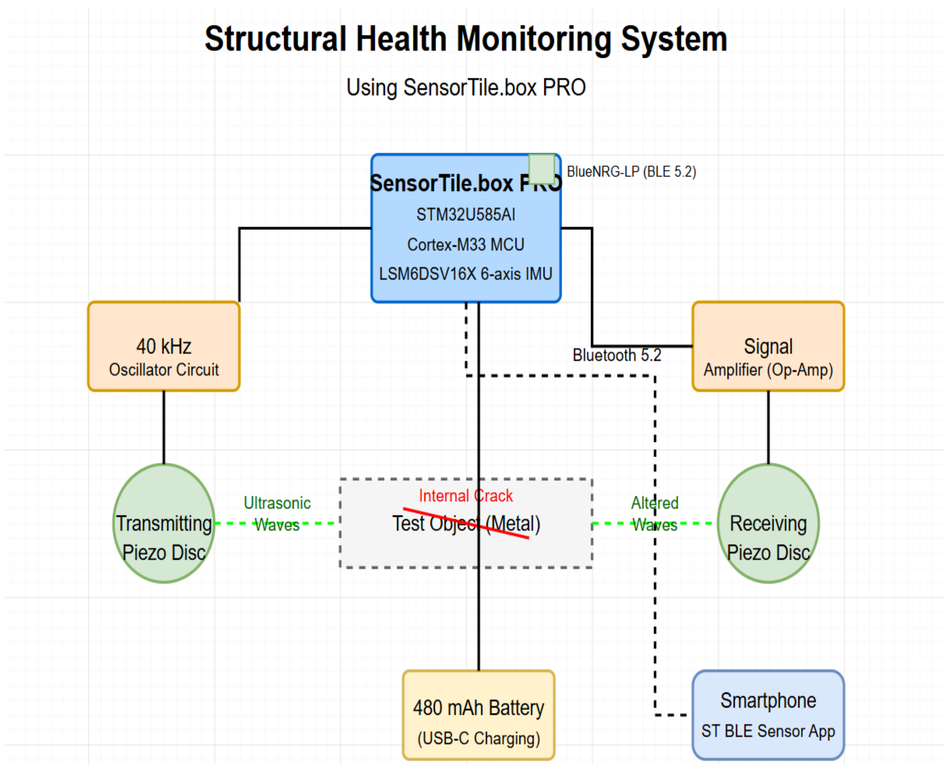
Key Features :

1. **Crack detection through high-frequency vibration analysis.**
2. **Real-time waveform visualization for structural integrity.**
3. **Non-destructive testing with piezoelectric sensors.**
4. **Compact, cost-effective, and portable inspection system.**

AI Implementation Details

- AI-powered analysis using Random Forest and Decision Tree algorithms for accurate crack detection and classification.
- Achieving a high Training Accuracy of 90%.

Block Diagram



Application

- **Structural Health Monitoring: Continuously assess bridges, pipelines, and buildings for internal cracks, preventing catastrophic failures through early detection.**
- **Aerospace and Automotive Inspection: Ensure the safety of aircraft components and vehicle chassis by identifying micro-cracks that could compromise structural integrity.**
- **Manufacturing Quality Control: Detect hidden defects in metal parts and welded joints during production, reducing waste and ensuring product reliability.**

Conclusion

This system, using piezoelectric sensors with Random Forest and Decision Tree algorithms, accurately detects internal cracks in metallic structures. It contributes to structural health monitoring by providing a low-cost, portable, and real-time diagnostic tool. This innovation enhances safety and reliability in industries like aerospace, construction, and manufacturing.

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