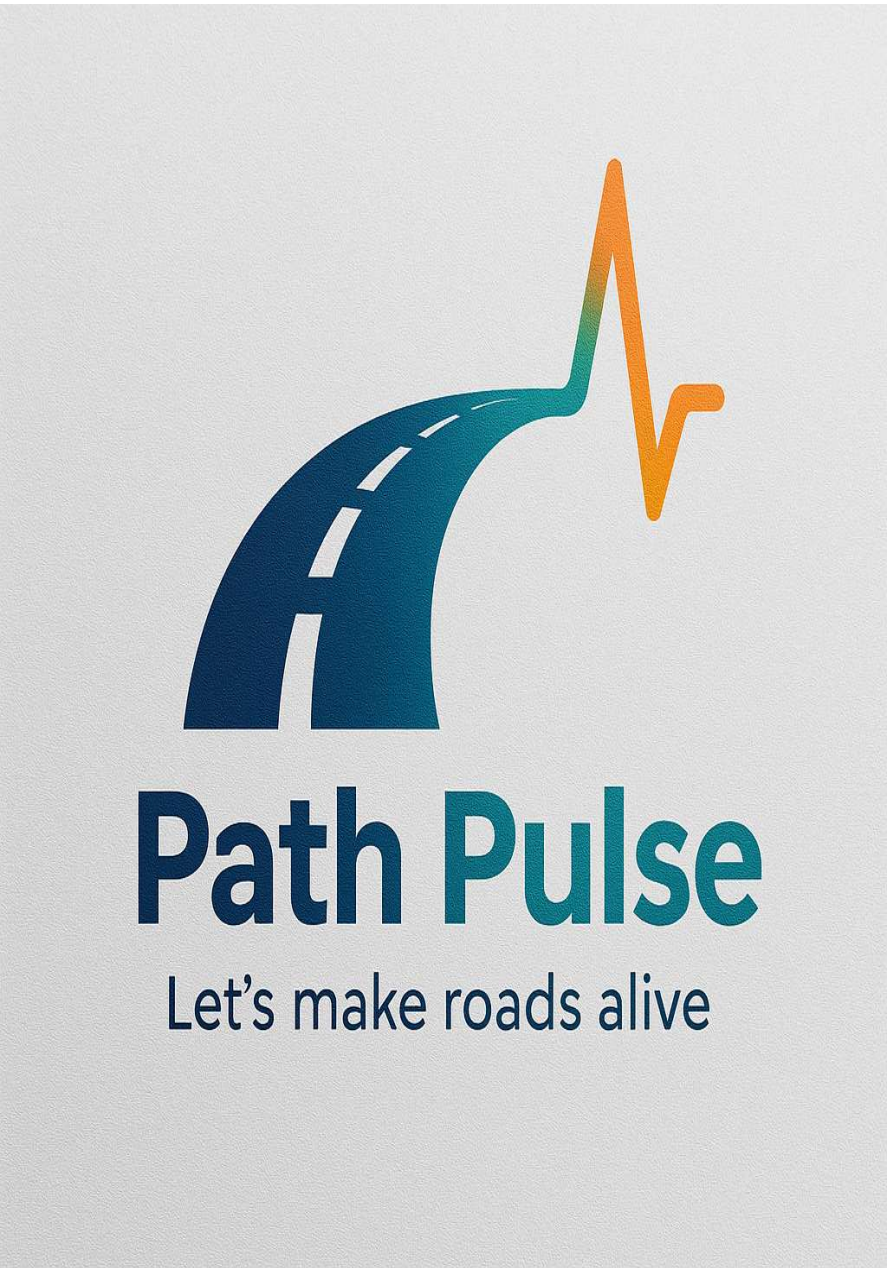
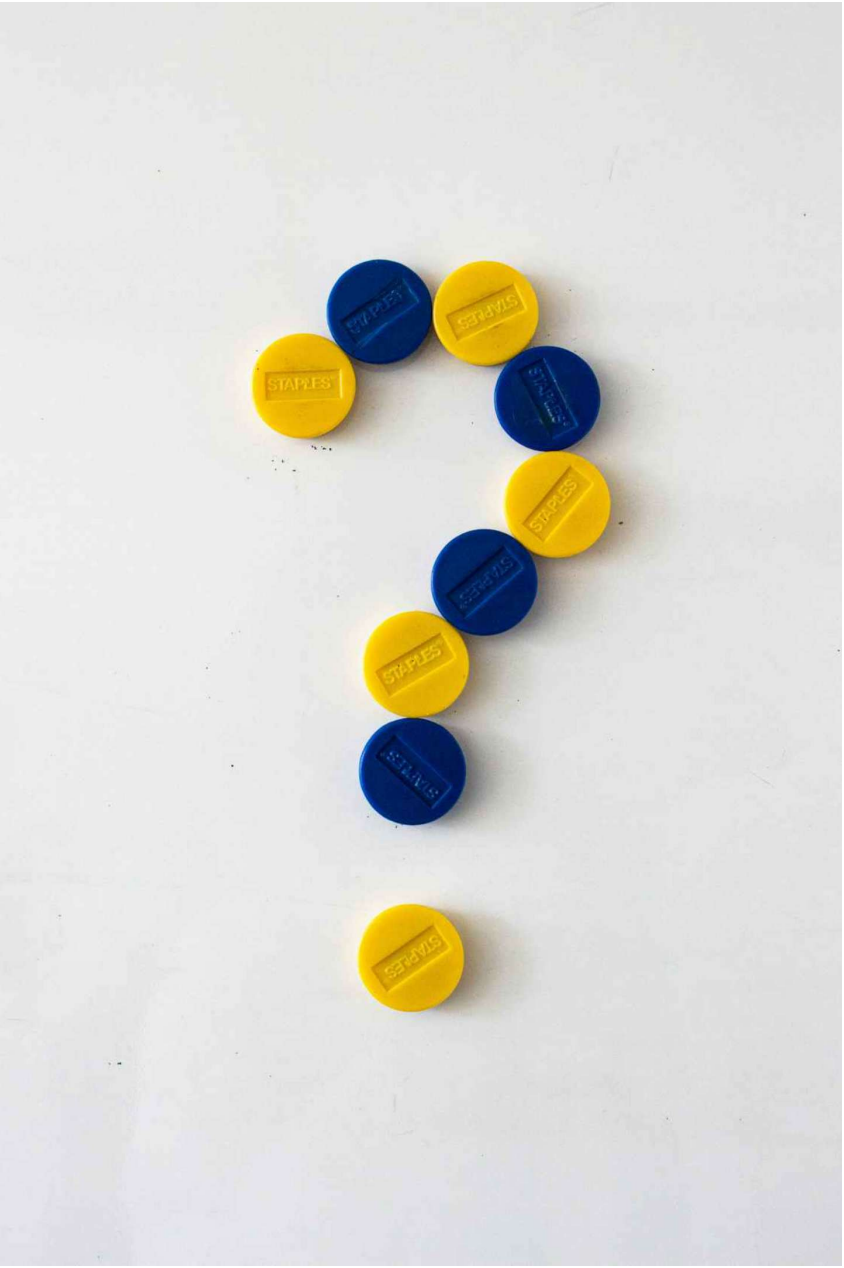


Pavement Pulse

Transforming Highway Data into Real-Time Decisions

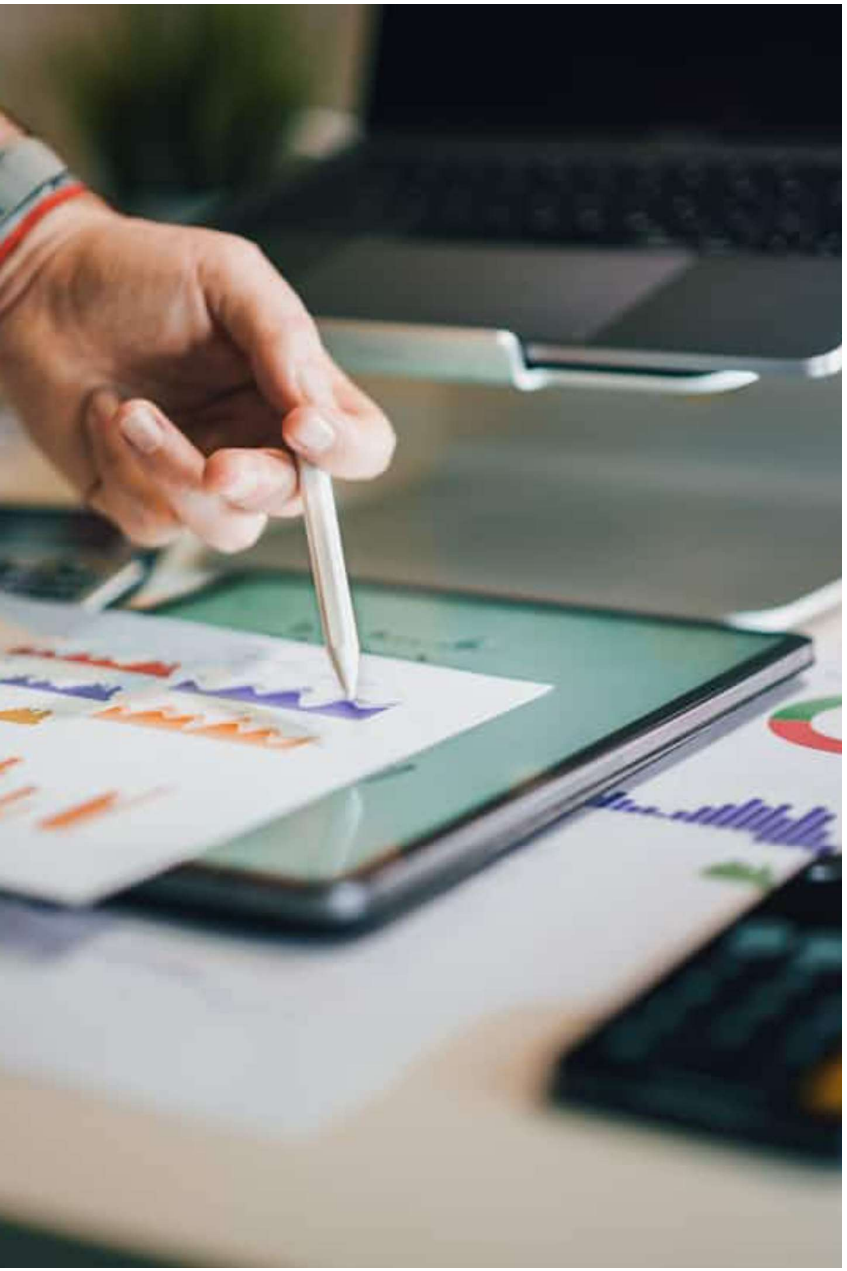
By: Anubhav Jain

NHAI Innovation Hackathon 2025



Why This Problem Matters

Highways require ongoing, attentive maintenance to ensure safety and efficiency. The National Survey Vehicle (NSV) gathers extensive pavement data, including video and location. Currently, the lack of real-time visualization limits engineers from accessing live data on-site, while HQ staff cannot remotely monitor surveys—this disconnect slows repair actions and decision-making crucial for road safety.

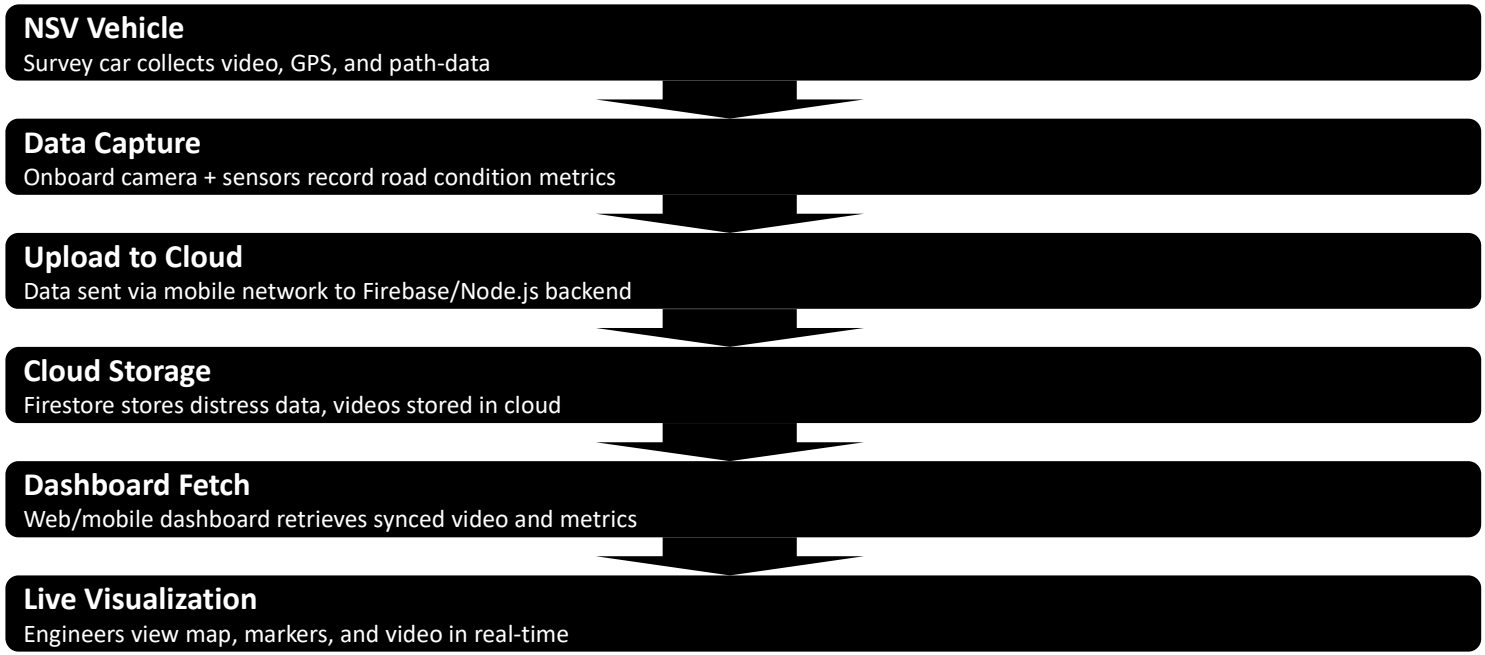


What I Observed in NSV Data

The NSV data includes GPS coordinates, vehicle speed, direction, chainage, video footage, and path distress markers. However, these data points are not synchronized or mapped together, causing difficulties in on-site usability and analysis. Report creation is manual and delayed, which hampers timely interventions during inspections.

The Core Idea

Path Pulse aims to "make road health visible, live, and actionable." By integrating a dashboard with a mobile tool, it displays NSV survey data in real-time on an interactive map. Video, GPS, and distress indicators are synchronized to empower both field engineers and remote teams to quickly assess and respond to road conditions.



Real-time: NSV → Cloud → Dashboard → Engineers

How It Works: Solution Architecture

1.NSV collects detailed survey data during highway inspections.

2. Data is uploaded to a secure cloud server instantly.

3. A dashboard processes and visualizes live map views, synchronized video playback, and key metrics like chainage and distress location.

4. Accessible anywhere via mobile or web login for seamless collaboration.

Key Features That Drive Impact

- **Interactive map showing live GPS tracking and distress markers.**
- **Video playback linked directly to survey locations for visual validation.**
- **Real-time display of speed, direction, and chainage metrics.**
- **Historical survey playback enabling trend analysis over time.**
- **Remote access empowers HQ and engineers to monitor surveys anywhere.**

Technical Stack Overview

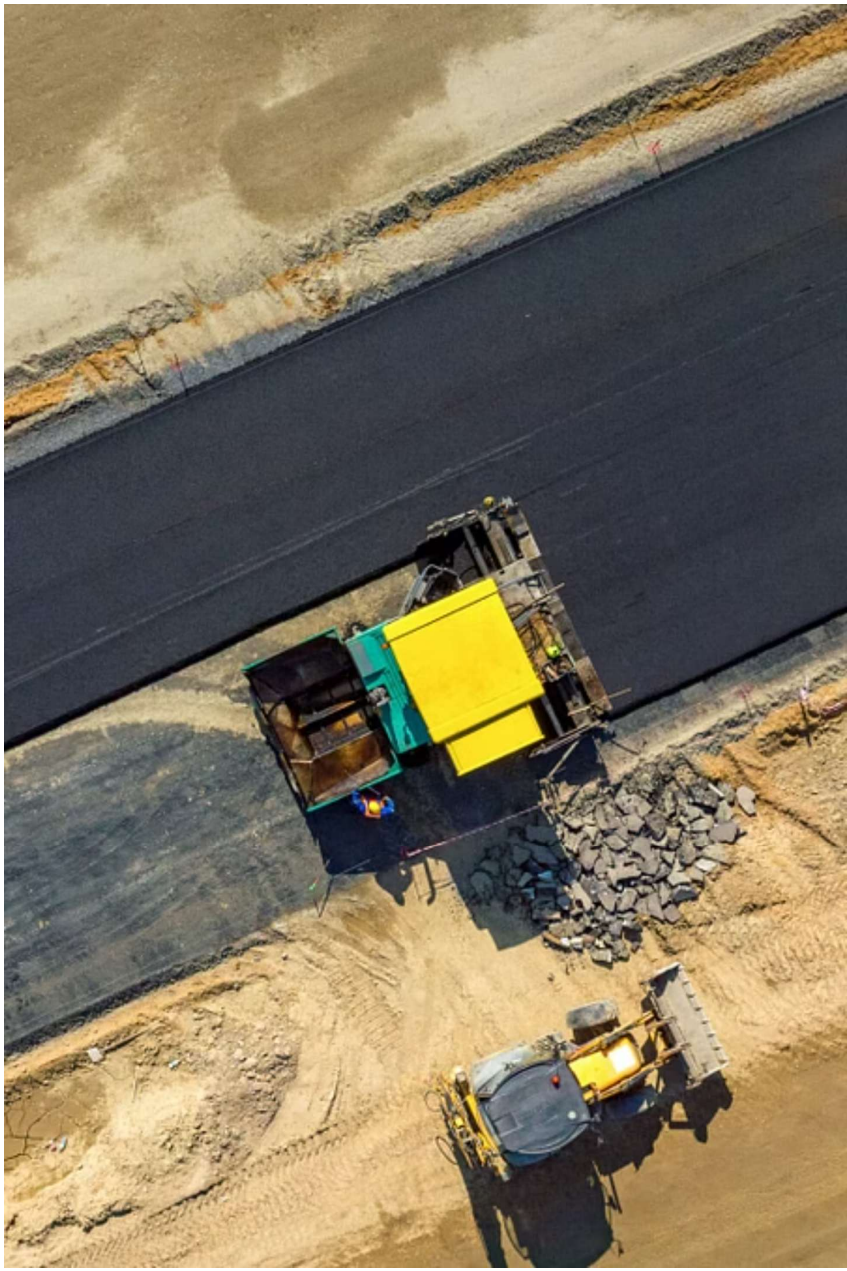
- We use modern, scalable, and open-source technologies:
  - Frontend: ReactJS and Flutter for web and mobile interfaces.
  - Maps: Google Maps and Mapbox for detailed geospatial visualization.
  - Backend: Firebase and Node.js for reliable data handling and streaming.
  - Video: MJPEG and RTSP streams integrated for live and recorded playback.
  - Storage: Firestore and Cloud Hosting for secure, scalable access.

Benefits for NHAI

Problem	What Path-Pulse Solves
• Delayed inspection reports	• Real-time map and synchronized video dashboard
• No HQ visibility during surveys	• Remote access to live survey data
• Unorganized and manual output	• Centralized, fast, and integrated user interface

Future Vision and Enhancements

- AI-driven automatic crack and rutting detection from video feeds.
- Integration of drone imagery with NSV data for comprehensive analysis.
- Predictive maintenance scheduling using historical data trends.
- Offline-first mobile mode to support surveys in low connectivity zones.



Thank You

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Let’s join forces to transform road inspections into real-time intelligence that improves safety and efficiency for everyone.