DASGPT

Give DAS Data a Voice

Infrastructure Safety Monitoring · Conversational AI Agent

Product Manual

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How This Manual Is Organized

Chapter	What's inside
1 · The Problem & the Backdrop	The real bind facing bridge-safety monitoring today, and where DASGPT fits in.
2 · Positioning & Core Value	What DASGPT is, who it serves, and how it differs at the root from traditional monitoring.
3 · What the Product Does Today	Capabilities that run and demo live right now — each with a sample conversation.
4 · Progress & What's Next	What the MVP has proven, and the direction of travel from here.

A note on scope: Chapter 3 covers only what is already working and can be shown live today. Anything still on the roadmap is kept in Chapter 4 and labeled explicitly as a planned direction — never presented as a shipped feature.

1 · The Problem & the Backdrop

1.1 Bridge safety is a public-safety problem that leaves no room for error

Bridges, tunnels, and roadbeds keep cities and traffic moving. When one of them fails structurally, the consequences are rarely small — they are catastrophic. And a large share of the world's bridges are now well into the back half of their service lives, where age and heavy daily use compound one another. The central, and hardest, question for the people who operate this infrastructure is deceptively simple: how do you catch a structure's quiet, invisible changes before any visible damage appears?

1.2 Three limits of traditional monitoring — and they stack

Conventional bridge-health monitoring has long run into three problems that reinforce each other:

- **Thin coverage, wide blind spots.** Discrete point sensors watch only a handful of spots on a bridge, leaving long stretches unmonitored in between. Worse, the sensors themselves age and break — they often fail before the bridge does, and the more critical the location, the harder it is to keep a sensor alive there for the long haul.
- **A data tsunami no one can read.** Distributed acoustic sensing (DAS) closes the coverage gap: a single fiber turns the whole span into a continuous line of sensors. But it trades one problem for another — the raw data arrives at gigabytes every ten minutes or so, a relentless flood far beyond what anyone can review by hand.
- **A high bar and a slow answer.** Turning those raw signals into a plain verdict — is the bridge safe right now? — takes a full chain of specialist algorithms: read the data, filter and denoise, extract features, run modal analysis, grade the alerts. In practice only a few

geophysics and structural engineers can run that pipeline by hand, and the result rarely reaches frontline inspectors or decision-makers in time, or in plain language.

1.3 "We have the data — we just can't read it"

So the field is stuck in an awkward place. Sensing technology can already record every breath and heartbeat of a bridge, yet that data sits quietly on a disk, legible only to specialists. Most software products on the market stop at "a dashboard plus an AI help desk": ask a question and you get an instruction manual back, not a real piece of professional analysis. Between the data and the decision, one role is missing — a translator.

That is exactly the gap DASGPT sets out to fill: to let anyone — a frontline engineer, an operations lead, a government administrator — ask, in one plain sentence, how the bridge is doing at this moment, and get back an answer that is backed by validated professional algorithms and traceable to its source.

2 · Positioning & Core Value

2.1 What DASGPT is

DASGPT is a conversational AI agent for infrastructure safety monitoring. It takes bridge-health analysis — work that used to require a trained engineer driving specialist tools — and turns it into a single sentence and a straight answer. You ask in everyday language; behind the scenes DASGPT drives a set of validated DAS algorithms to query data, compute metrics, draw the standard engineering figures, and assess health — then explains the result back to you in plain terms.

2.2 Who it's for

Who	What they need	What DASGPT changes
Frontline inspection & O&M	To know quickly where to focus on the bridge today	An answer to a single question — no waiting on an engineer's report.
Structural & bridge engineers	To dig into modal frequencies, strain, and anomalous segments	One sentence calls up the specialist algorithms and figures — no hand-run scripts.
Managers & decision-makers	To see overall health and keep an archivable record	A verdict and a formal report in seconds, ready to support a decision.

2.3 What makes it different at the root

In one line: the old way makes people work to read the data; DASGPT makes the data speak to people. The difference is not a chat box bolted onto a dashboard — it is a reliability-first "domain agent" design:

- **The AI orchestrates; validated algorithms do the work.** The model's job is to understand the question and decide which professional capability to call. The actual computation runs entirely on a set of algorithms pre-validated by domain experts — so the AI never improvises an analysis on the fly.
- **Raw data never enters the model.** The bridge's massive raw waveforms stay in the backend the whole time and never pass through the AI's "mind." Only the compact results come back — which is faster, cheaper, and rules out fabricated numbers at the source.
- **Every conclusion is traceable.** Each answer traces back to which algorithm ran, with what parameters, over which data — not a vague "the AI said so." Results are reproducible, credible, and auditable enough to stand behind an engineering decision.

The core idea — give DAS data a voice: turn signals only an expert could read into a health answer anyone can ask for.

2.4 The sensor in one minute: how DAS works

It helps to picture the sensor itself, because it is unlike anything bolted to a bridge today. There are no instrument boxes along the span — just one ordinary fiber-optic cable running its length. A box of electronics fires laser pulses down the fiber, and every meter of glass echoes a faint signal back. That single cable becomes thousands of vibration sensors. The technique is DAS — distributed acoustic sensing — and it is what makes full-span, meter-by-meter coverage possible from one durable, low-cost cable.

Figure 2-1 · One fiber, thousands of sensors: the DAS cable and interrogator behind the dashboard.

3 · What the Product Does Today

Everything below runs and demos live right now. Each capability comes with a short "how you'd ask, how it answers" exchange to make the experience concrete.

3.1 The monitoring dashboard, at a glance

Before a single question is asked, DASGPT already presents a full operations dashboard for the bridge — and it is worth a tour, because the AI assistant and this screen read the same data and move together. The screen has three layers:

- **An environment strip.** Bridge name and location, live on-site weather, the clock, a short profile of the structure, and an entry to its surveillance camera.
- **The two bridge-shaped panels at its heart.** Each green bar is one measuring point on the real bridge — a hundred of them end to end, one per fiber channel. Green means healthy, red means an anomaly, and you locate a problem at a glance. One click swaps this bar view for along-bridge curves.
- **Time-history columns, left and right.** Strain on the left, resonance frequency on the right, each switchable across minute / hour / day / month, with a five-level alarm bar chart and a stack of alarm cards (which point, what level, exactly when).

A top toolbar lets you drill into any single sensor, swap between recorded datasets, and flip the entire screen between Chinese and English in one click.

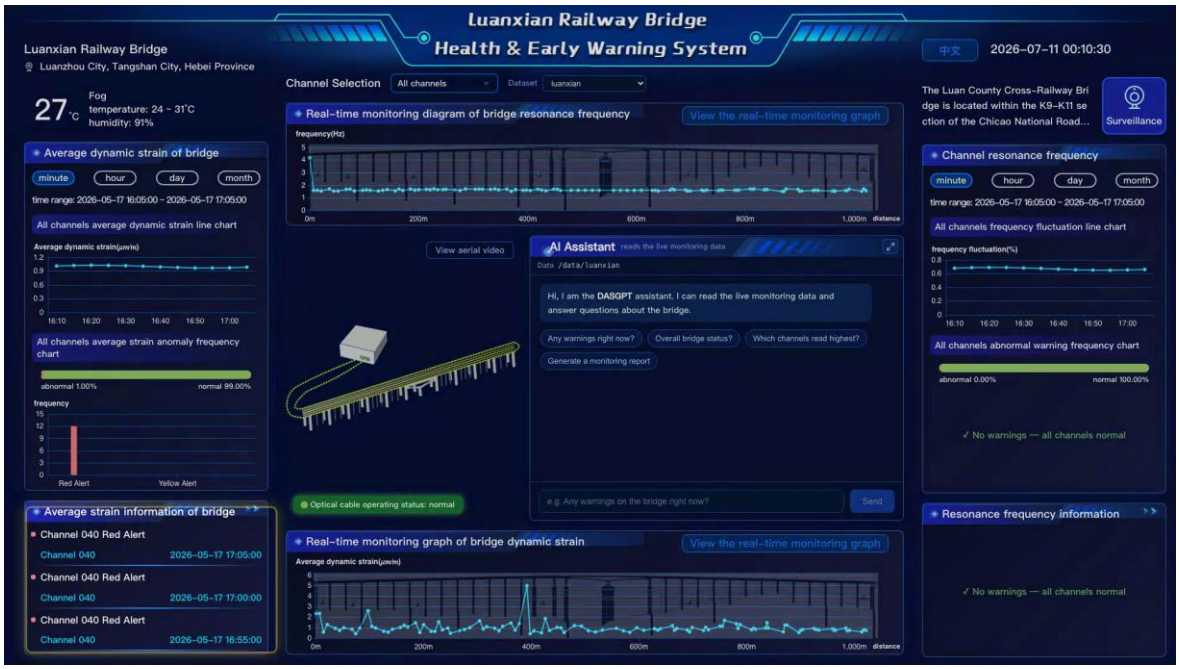

Figure 3-1 · The monitoring dashboard: bridge-shaped health panels, environment strip, and the built-in assistant.

3.2 Ask about bridge health in plain language

This is the front door, and the core of the experience: you ask a plain-language question about the bridge, and DASGPT decides which analysis to run and which capability to call, then explains

the result in everyday terms — with the basis for its conclusion attached. No menus, no scripts, one sentence is enough.

User: How's the bridge doing overall in the latest data — anything I should keep an eye on?
DASGPT: I ran a full pass on the current data. Overall health reads as a minor watch. Along the span, two segments show clearly elevated strain, the most pronounced around 312–318 m. How I got there: I computed strain rate, power spectra, and per-channel RMS across every channel, and flagged anything above five times the bridge-wide median. Want a distribution plot along the span, or a full report?

Figure 3-2 · A one-sentence question returns a health verdict — 99 channels normal, one red warning at Channel 40 (~392 m).

3.3 Transparent reasoning — every answer shows its work

DASGPT doesn't just hand you a conclusion. Every answer can expand to show the reasoning behind it: open the thinking, and you can read exactly how the assistant reasoned — which tools it considered and how it weighed the numbers — before it spoke. It extends "traceable" from the data layer all the way into the reasoning.

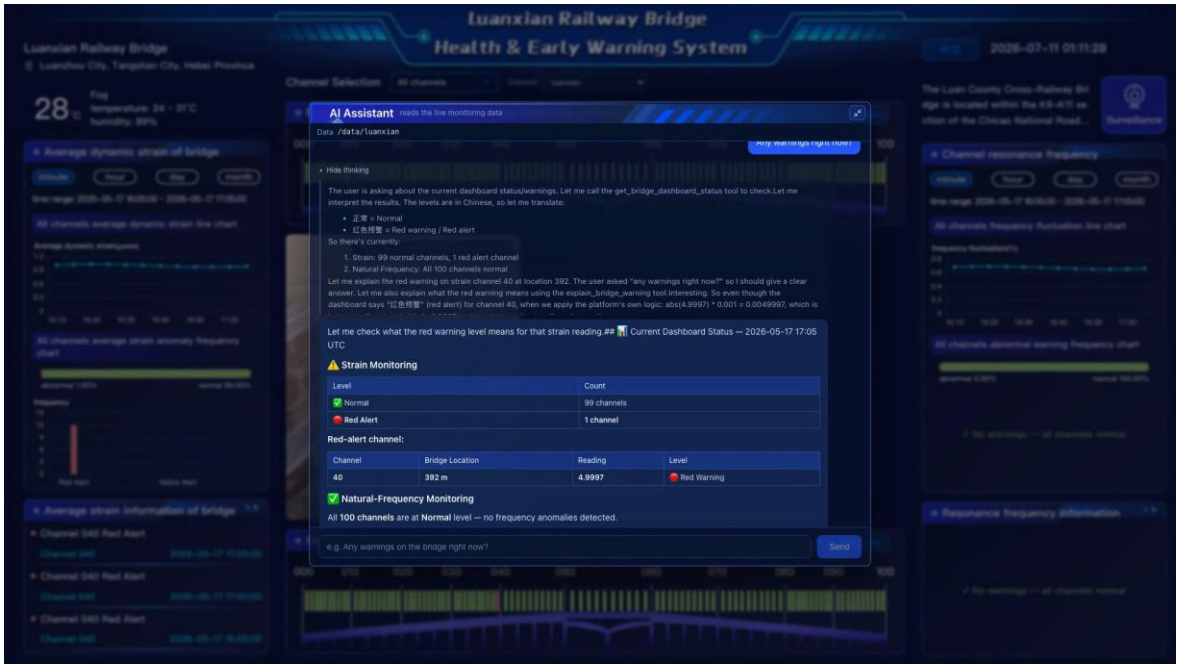

Figure 3-3 · Expand "Show thinking" to read the assistant's reasoning before it answers.

3.4 A proactive copilot — guided next steps and raw-data re-verification

DASGPT behaves less like a search box and more like a copilot. When it flags something, it weighs the plausible causes — a genuine load event versus a sensor hiccup — and offers to re-check the finding against the raw fiber recordings rather than leaving you to interpret it. After each result, it proposes the next move on its own: a deeper analysis, a full report, or publishing to the dashboard. The re-verification step is what turns a raw alarm into a trustworthy call.

User: What does the red warning on Channel 40 mean? Should we be worried?
DASGPT: Red is the top tier, so it's worth attention. It flags abnormally high strain at that location — which could be a real load event, a sensor glitch, or a cable-coupling issue. I can re-analyze the raw fiber recordings to tell those apart and confirm it. Want me to?

3.5 Structural health monitoring — strain, vibration, modal frequency, tiered alerts

Working from the DAS vibration data, DASGPT continuously computes and interprets the bridge's key health indicators, turning complex signals into a clear picture of its condition:

Dimension	What it captures
Dynamic strain / RMS	Per-channel dynamic-strain intensity — the load and vibration level along each segment.
Power spectral density (PSD)	The frequency makeup of the vibration — the basis for reading structural behavior.

Natural / modal frequency	The bridge's own resonant frequencies — its "ECG"; a shift is an early warning of damage.
Anomalous-segment localization	Automatically groups high-strain channels into segments, with a position range and relative severity.
Overall health grade	A single verdict for the whole structure — normal / minor / moderate / severe.

User: Give me a read on this bridge's vibration and modal frequencies.
DASGPT: Done. The first few natural frequencies land around 2.4, 3.8, and 5.6 Hz; bridge-wide dynamic-strain RMS sits in the normal band, with a couple of segments called out separately. The modal frequencies track the historical baseline — no sign of a broad stiffness loss. Want the PSD spectrum, or the RMS distribution?

3.6 Five-level alerts with transparent thresholds

DASGPT uses the same five-level alarm scale as the monitoring platform, so every reading carries a clear risk level. More importantly, it can explain why a reading sits at that level — which threshold, how the value converts, where the number comes from — instead of just throwing a color on the screen.

Level	Meaning
Red	Highest risk — verify on site immediately.
Orange	Elevated risk — watch closely.
Yellow	Moderate risk — put under observation.
Blue	Slight deviation — note the trend.
Normal	Within the normal band.

User: Why is this segment an orange warning? What does that mean?
DASGPT: Orange means the reading falls between tiers 3 and 4 of the scale — above yellow, below red. I can lay out the exact thresholds, how the value converts, and where the judgment comes from, so the call is fully traceable. For this segment, I'd keep it under close watch and track the trend as new data comes in.

Figure 3-4 · The assistant explains an alarm level, weighs the likely causes, and proposes next steps.

3.7 Standard engineering figures, generated on request

A single sentence has DASGPT produce the standard figures used in structural monitoring and drop them straight into the conversation — no manual plotting. Four standard figures are supported today, alongside general-purpose charts (line / bar / scatter / pie) on demand:

Figure	What it shows
Space–time waterfall (strain rate)	The whole span across time at a glance — anomalous events jump right out.
Distance–frequency PSD heatmap	Frequency-energy along the span — pinpoints where and in which band anomalies concentrate.
Reference-channel PSD curve (with modal peaks)	Cleanly marks the peak of each natural frequency.
Along-span RMS distribution	The spatial profile of vibration intensity — shows which segments run high.

User: Give me the along-span strain (RMS) distribution.
DASGPT: Here's the along-span RMS plot. Most of the span is steady; there's a clear rise around 312–318 m, matching the anomalous segment I flagged earlier. Want a PSD spectrum alongside it to compare?

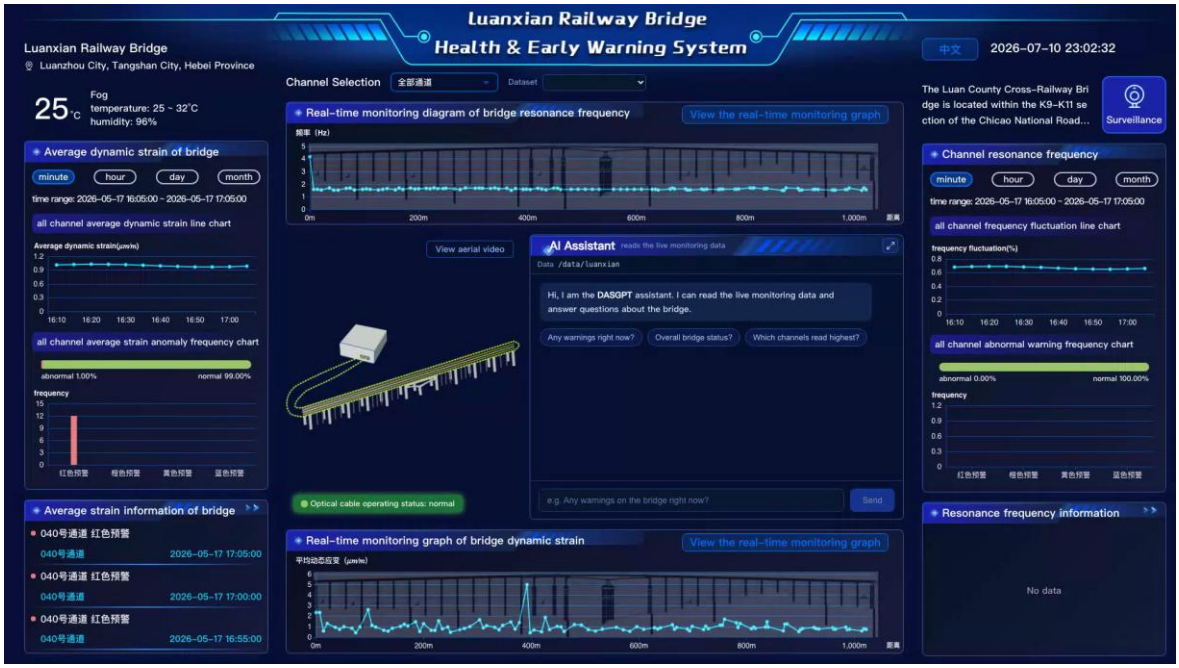

Figure 3-5 · Along-bridge curves: resonance frequency (top) and strain (bottom), with the spike near 392 m.

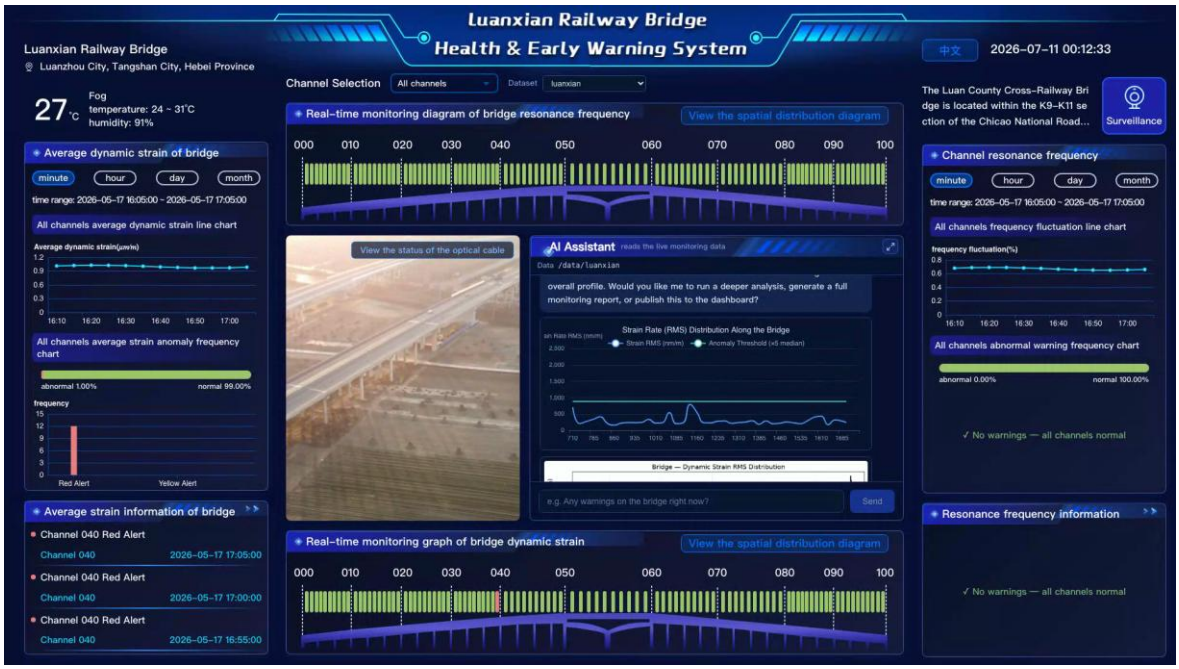

Figure 3-6 · A standard figure drawn directly in the chat in response to one sentence.

3.8 One-click monitoring report (Word / .docx)

Say "generate a monitoring report," and once the analysis is done DASGPT assembles a formal Word report on its own: title, key facts, the health verdict, a key-metrics table, the standard figures, and an AI-written diagnosis with recommendations — plus a download link. The report language follows the interface (Chinese or English), ready to file or hand up the chain. Minutes, not days.

User: Put together a report for this monitoring run.
DASGPT: Report's ready to download. Headline: overall minor watch, with the 312–318 m segment as the main focus. Inside you'll find the key-metrics table, four standard figures, and a diagnosis with inspection recommendations.

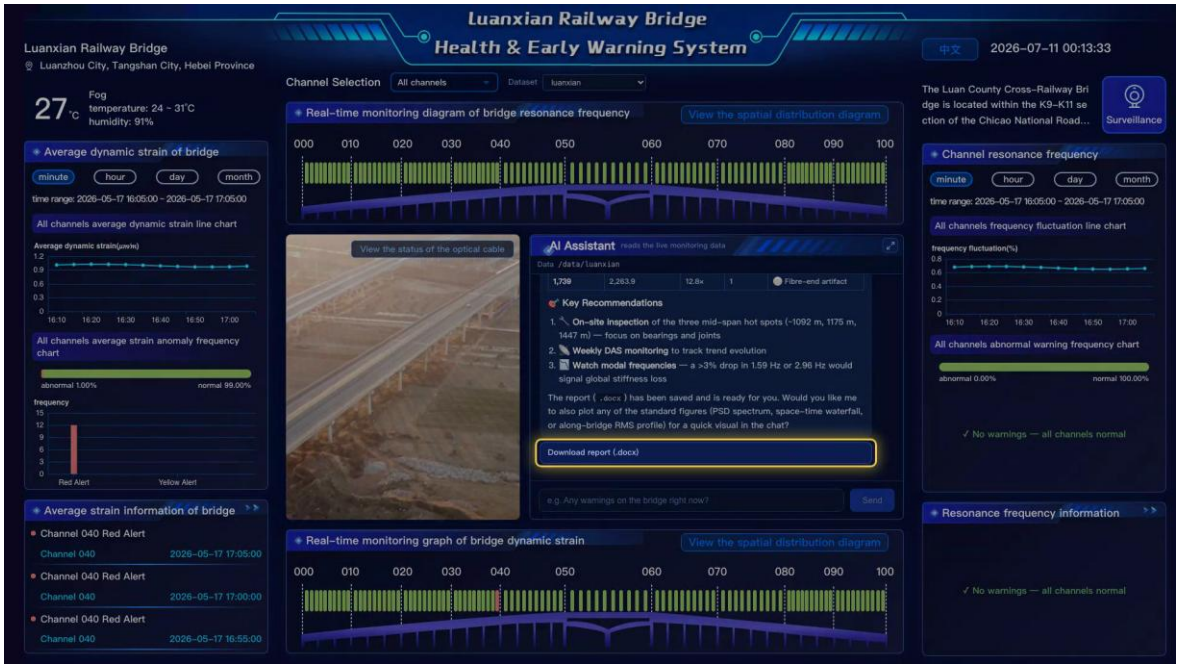

Figure 3-7 · A formal Word report — flagged hotspots, prioritized actions, standard figures — ready to download.

3.9 Switch datasets or bridges in one step

Working across several bridge projects or multiple recordings, DASGPT switches its subject in a single step: pick a bridge's data, and the whole analysis and dashboard follow. The chat analysis and the big-screen display stay consistent — no data bleeds between bridges.

User: Switch to the other bridge's data.
DASGPT: Switched. Analysis and the dashboard now run on that bridge — go ahead and ask about its health.

3.10 Live-dashboard integration, and closing the loop

DASGPT links with the monitoring dashboard both ways. It can read the screen's current live-alarm state and answer in plain language, and it can push an analysis back onto the screen — mapping anomalies to their real channel positions on the bridge and lighting up the whole board, ideal for briefings and command settings. That closes the loop: raw cable data comes in, verified results go up on the screen, the report is filed — the entire pipeline run by a single conversation, with dashboard and assistant always in step.

User: What's the bridge showing on the big screen right now? How many channels are in alarm?

DASGPT: Right now: most channels normal, a few in yellow/orange. I can list the flagged channels and their positions.

User: Push this analysis to the dashboard.
DASGPT: Done — pushed and lit up. The anomalous segment is mapped to its real position on the bridge; you can see it live on the screen.

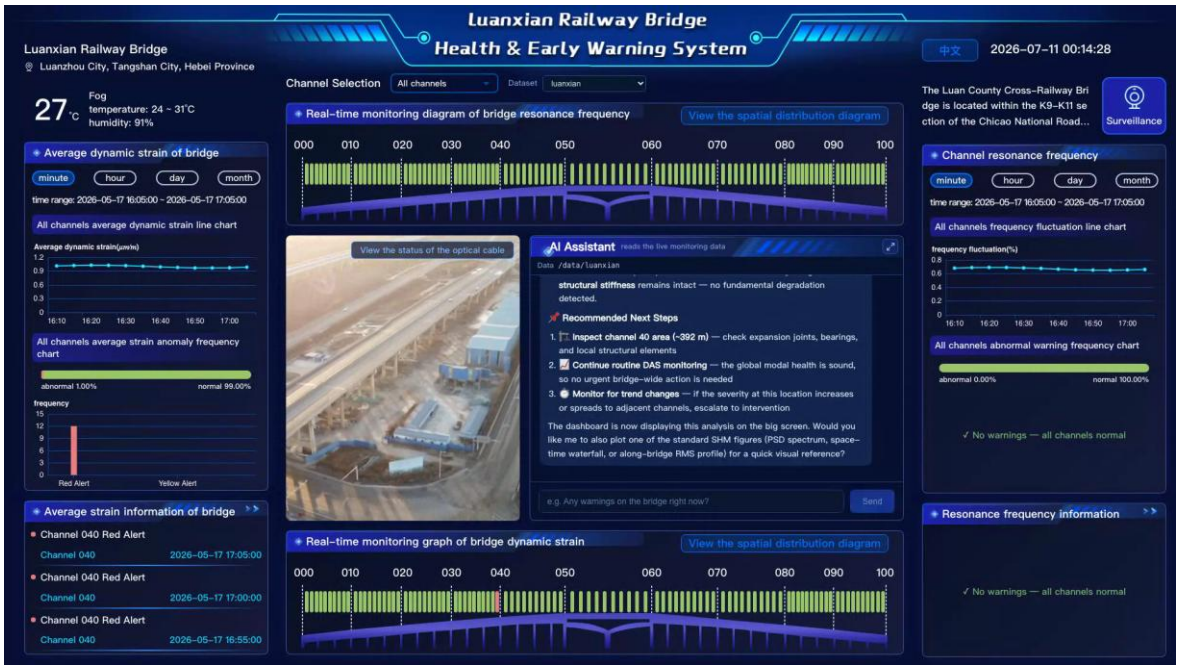

Figure 3-8 · The verified analysis published back to the live dashboard — closing the loop.

3.11 Data management and file access

Underpinning all of this is a set of general-purpose capabilities: set or switch the active data directory, list and read data files, fetch the current time, and so on — so the whole analysis flows smoothly from within the conversation.

3.12 Bilingual by design — Chinese and English in one click

Both the dashboard and the assistant switch between Chinese and English in a single click, and generated reports follow the interface language. The same product speaks to a local operations team and to international reviewers or owners without missing a beat.

4 · Progress & What's Next

4.1 Where we are: an MVP with the core loop already working

DASGPT is at the MVP (minimum viable product) stage. Around its first vertical — bridge structural-health monitoring — the product already runs a complete core loop end to end:

Plain-language question → automatic dispatch to validated algorithms → computed health metrics and localized anomalies → standard engineering figures → a one-click monitoring report → publication back to the live dashboard.

That loop has been validated on sample data from a real bridge project, proving that the core experience — giving DAS data a voice — holds up both technically and as a product.

- **Validated today.** Conversational bridge-health analysis; five-level alerts with transparent explanations; automatic standard figures; one-click Word reports; dataset switching; and two-way live-dashboard integration.
- **A reliability foundation.** The architecture — validated algorithms up front, the AI only orchestrating, raw data kept out of the model — is what makes the results reliable, reproducible, and auditable.

4.2 Where we're headed

With the core loop proven, DASGPT's next steps run along four lines. (These are planned directions, not yet-shipped features.)

- **Real-time.** Move from looping sample data to live data streams and cloud storage, supporting 24/7 online monitoring with real-time early warning.
- **Multi-modal.** Beyond bridge structure, fold in more sensing dimensions on the same conversational entry point — road-subgrade health, traffic flow and vehicle-speed recognition, dynamic vehicle-weight estimation (weigh-in-motion), dam and embankment safety, slope stability, tunnels and underground pipe networks — toward an integrated road–bridge–tunnel–slope monitoring system. These directions already rest on real field work: on the Chicao (Chifeng–Caofeidian) G508 highway, DAS has been applied to subgrade imaging, traffic-event detection, and vehicle-weight estimation (most vehicles within about one tonne of error), while dedicated research on DAS-based bridge SHM and vehicle-weight estimation underpins the modal-frequency and load-inversion methods.
- **Engineered for the field.** Standardize alarm thresholds and report templates, and calibrate them on site against specific bridge types to match real operating practice.
- **Built to scale.** Support large-scale, multi-bridge, multi-project deployment and unified data management, extending toward full asset-lifecycle management.