



iRAMA.AI - Intelligent Road Asset Monitoring & Assessment

Edge-AI platform for real-time road condition monitoring

SAFETRIP Lab, IIT Roorkee

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and

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Indian Institute of Technology Roorkee (IIT Roorkee), India*

Supported By:



विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY



The National Challenge



India loses nearly **₹4.3 lakh crore** every year due to road issues, approximately 3% of India's GDP.



Current road surveys **are costly, inconsistent, and manual** (once or twice a year, most on highways).



Result: **late repairs, higher lifecycle cost, and unsafe roads**



Lack of **digital road health and asset management system.**



Digitize India's Roads through AI & Edge Computing.



Deliver real-time geo-referenced road data for smart mobility

"From Manual Inspection to Intelligent Monitoring"

iRAMA Framework



EDGE-AI DETECTION



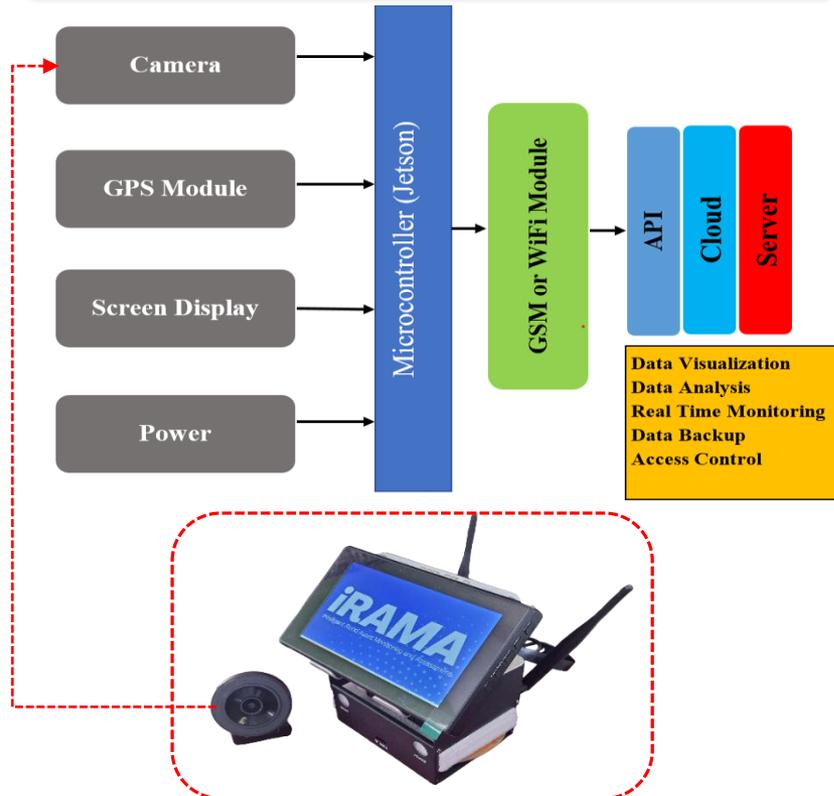
GEO-TAGGING



DASHBOARD

Unified Edge-AI + Cloud Dashboard Framework

Hardware Innovation



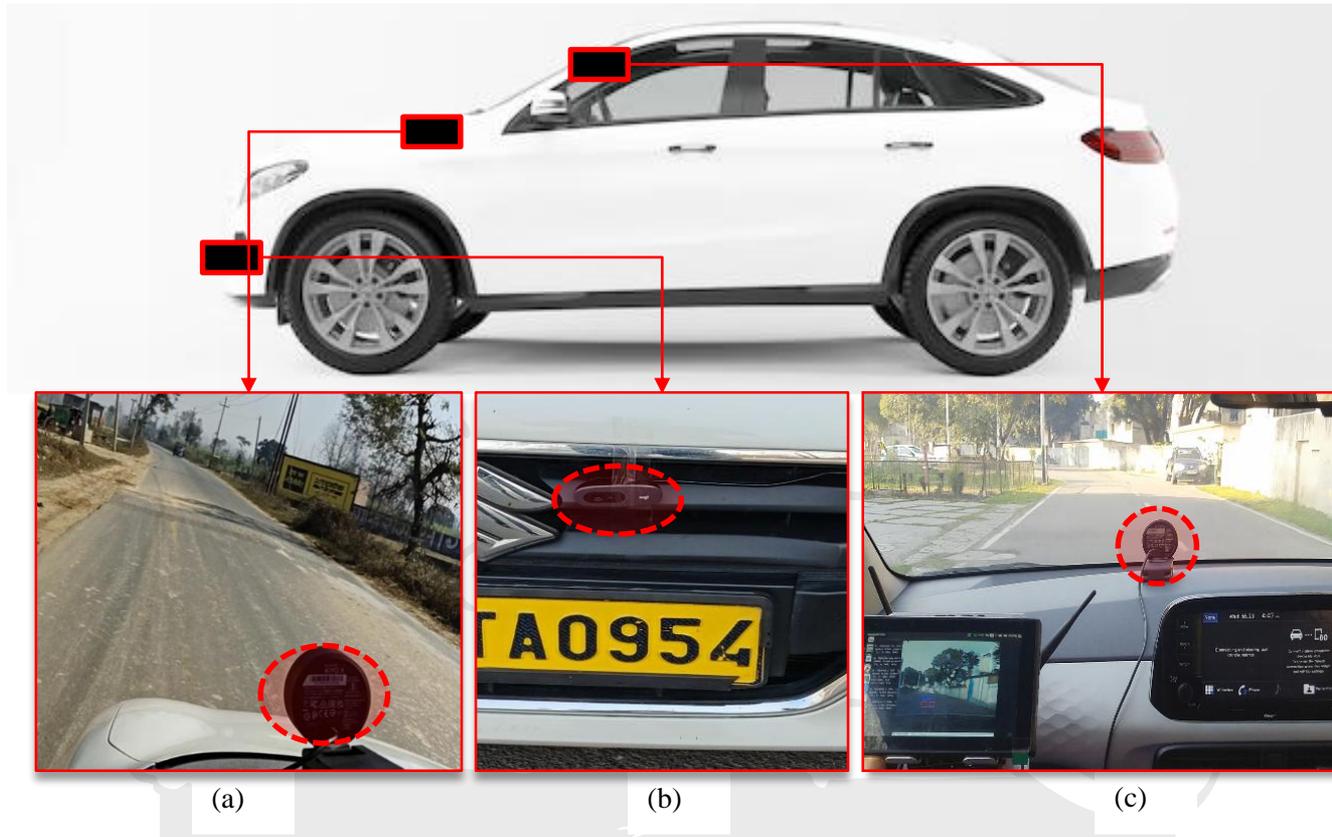
Edge-AI Device Architecture

- NVIDIA GPU-based edge processor
- HD camera and GPS Module
- 7" touch display for GUI and control
- 4G GSM / Wi-Fi connectivity
- Hybrid power system (car + internal UPS)

Key Features

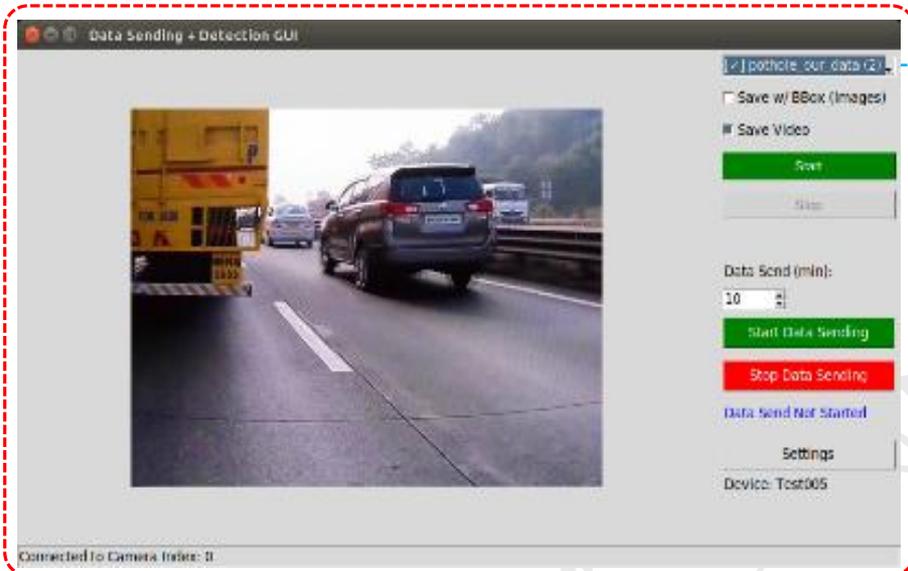
- Real-time AI detection & geo-tagging
- Edge inference > 10 FPS
- Secure cloud data sync
- Portable and vehicle-mounted design

Camera Mounting Strategy



Camera mounting positions: (a) windshield exterior, (b) front grille, and (c) dashboard interior.

On-Device GUI



User-friendly operation

- Automatic boot-up
- Model selection dropdown
- Live detection preview
- Configurable data upload:
 - Real-time
 - Interval-based
 - Snapshot / video options



GUI for model selection, live feed display, and configurable data sending.

Field Deployment & Real-World Validation



Performance Highlights



Detection accuracy > 80-90 % (multi-class)



Real-time edge inference > 10 FPS



Survey coverage \approx 250 km/day per vehicle



Hybrid power (vehicle + UPS)
- zero downtime

TRL-7 Market-ready prototype

Validation & Outcomes

- ✓ Cross-checked against on-ground distress records
- ✓ Reliable under diverse city traffic & weather conditions



Privacy-protected data, vehicles and people automatically blurred before cloud upload

Detection Coverage & Anomaly Flags

- What We Detect • What We Flag

Road Distresses

- Potholes; alligator & longitudinal cracks
- Faded lane markings & crosswalks



Covers
15+ classes

Road Assets

- Traffic signs — **Warning / Mandatory / Informatory**
- Crash barriers & guardrails
- Manholes

Asset Anomalies

- Damaged / missing **traffic signs**
- Damaged **guardrails / crash barriers**
- Open / damaged manholes

All detections are **geo-tagged & time-stamped** for action and audit.

Detection Coverage & Anomaly Flags

- What We Detect
- What We Flag



S No	1
Type	Pothole
Details	N/A
Timestamp	2025-12-04 13:15:04
Location	29.695893, 77.849572
DeviceID	IR006

Detection Coverage & Anomaly Flags

- What We Detect
- What We Flag



S No	3
Type	Pothole
Details	N/A
Timestamp	2025-12-04 11:10:05
Location	29.041338, 77.685528
DeviceID	IR006

Detection Coverage & Anomaly Flags

- What We Detect
- What We Flag



S No	2
Type	Alligator Crack
Details	N/A
Timestamp	2025-12-04 13:16:17
Location	29.705786, 77.849845
DeviceID	IR006

Detection Coverage & Anomaly Flags

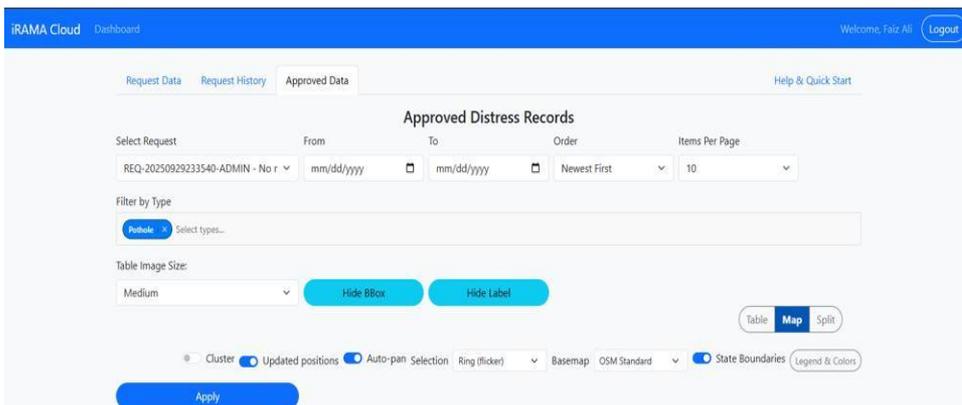
- What We Detect
- What We Flag



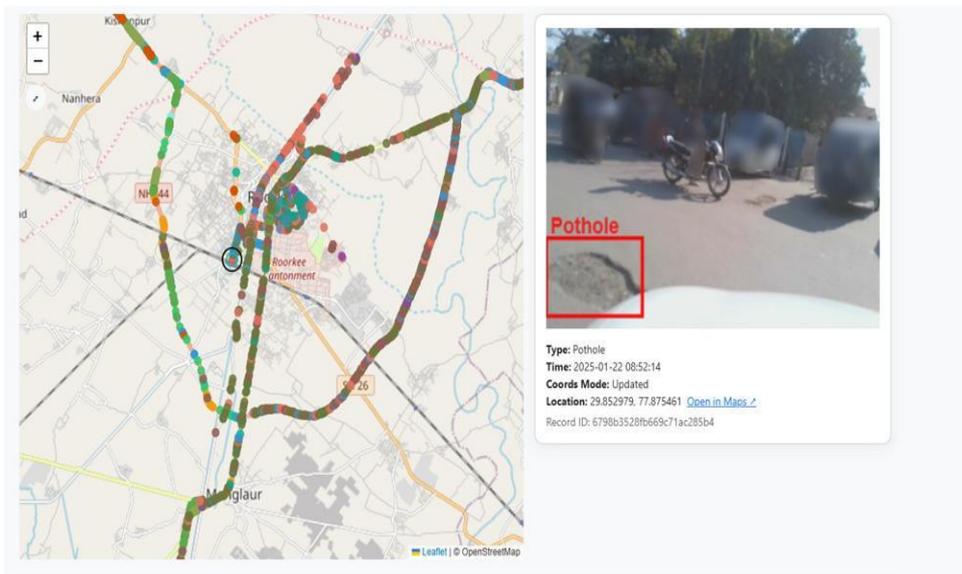
S No	4
Type	Advertisement Board
Details	N/A
Timestamp	2025-12-04 07:51:30
Location	28.625203, 77.311205
DeviceID	IR004

User-Specific Cloud Dashboard

Access, visualize, and download geo-referenced road data



The dashboard interface includes a top navigation bar with 'IRAMA Cloud Dashboard' and a user profile 'Welcome, Faz Ali' with a 'Logout' button. Below this are tabs for 'Request Data', 'Request History', and 'Approved Data', along with a 'Help & Quick Start' link. The main section is titled 'Approved Distress Records' and features a table with columns for 'Select Request', 'From', 'To', 'Order', and 'Items Per Page'. A filter section allows users to 'Filter by Type' (currently set to 'Pothole') and 'Table Image Size' (set to 'Medium'). There are also buttons for 'Hide BBox' and 'Hide Label'. At the bottom, there are controls for 'Cluster', 'Updated positions', 'Auto-pan Selection', 'Ring (clicker)', 'Basemap' (set to 'OSM Standard'), and 'State Boundaries'. An 'Apply' button is located at the bottom left of the filter section.



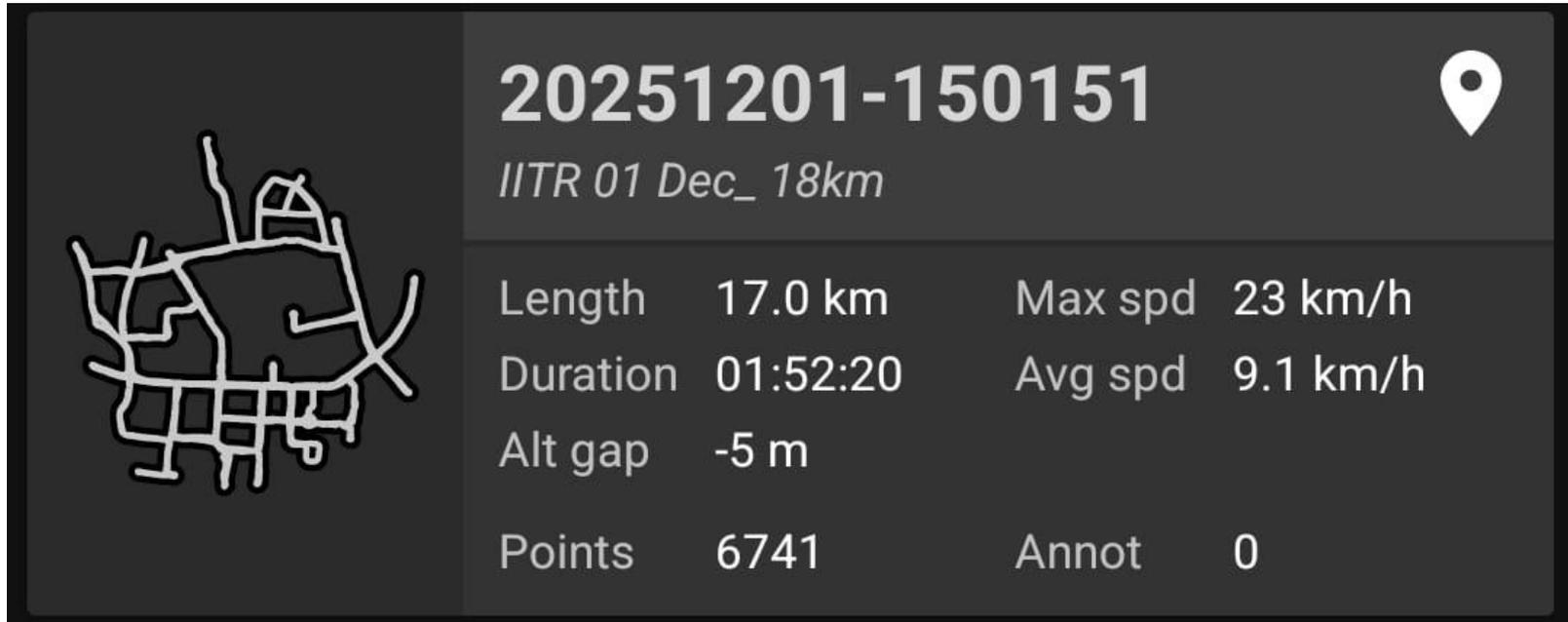
The map view shows a street network in Roorkee with various colored markers indicating different types of road distress. A specific pothole is highlighted with a red circle. An inset window provides a detailed view of the pothole, showing a close-up of the road surface. Below the inset, the following details are provided:

- Type: Pothole
- Time: 2025-01-22 08:52:14
- Coords Mode: Updated
- Location: 29.852979, 77.875461 [Open in Maps ↗](#)
- Record ID: 6798b3528fb669c71ac285b4

Key Highlights:

- 🏠 Client-specific portal
 - 📍 Geo-tagged & timestamped
 - 🗺️ Map & Table view
 - 📂 Data request & download
 - 🔍 Filter by type, date, or survey route
 - 🌐 Accessible through: cloud.irama.ai
- Coming Soon:**
Quantification (beta): pothole area/volume & assets anomaly metrics.
 -City/ward-wise summary reports and citizen-reporting integration are in active development.

IIT Roorkee Campus Pilot: Geo-Referenced Mapping Output



- ❑ Field pilot conducted on **IIT Roorkee campus** using the in-vehicle edge-AI system (camera + GPS + onboard inference).
- ❑ **Scale achieved: 15+ km surveyed; 3500+ geo-referenced detections** generated as a GIS-ready inventory.
- ❑ Outputs available on dashboard: **route trace + map pins + image evidence** linked with GPS and time.

User Dashboard



iRAMA Cloud

Login

Email or Username

Password

Show Password

Login

[Forgot Password?](#)

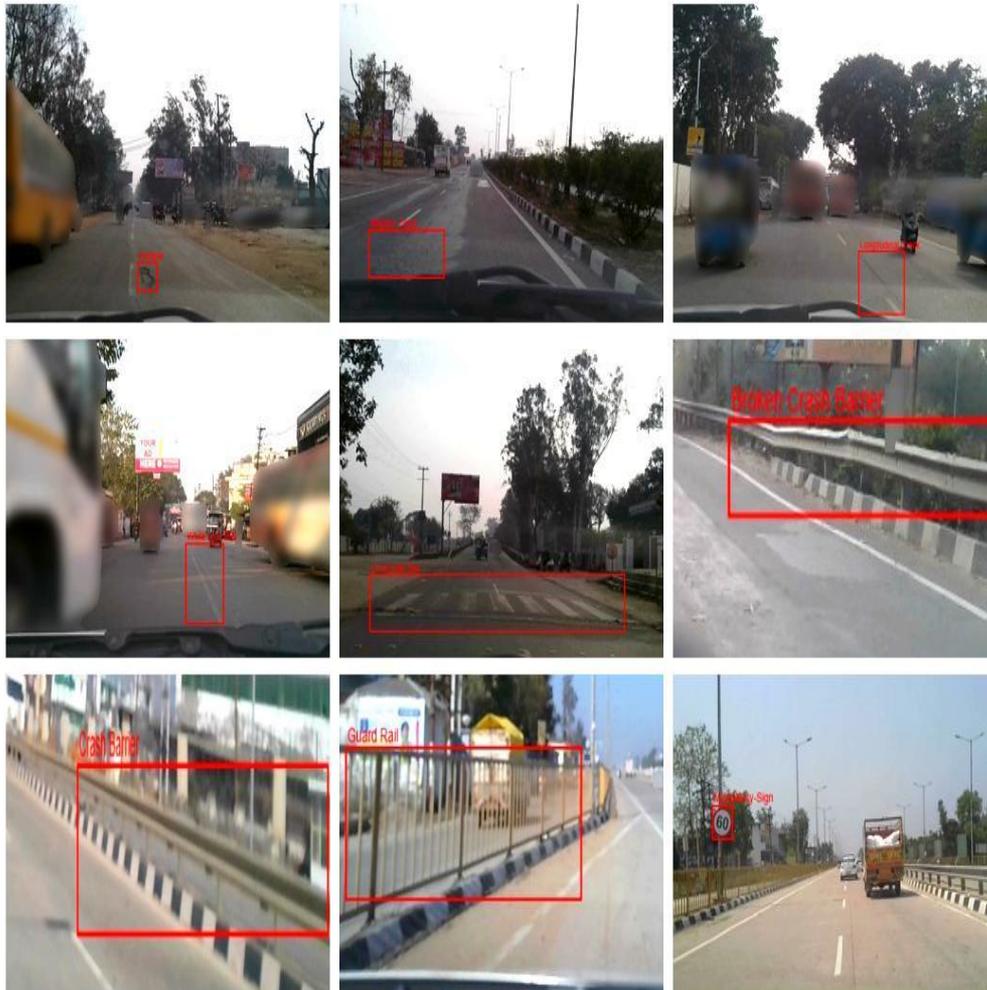
Don't have an account? [Sign up here](#)

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Dataset & Road History: iRAMA-Net

A living, geo-referenced history of road health for Indian roads



25k+ Time-stamped, geo-referenced images for every survey run



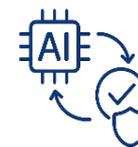
Road-wise history, see how any location evolved across months/years



15+ classes: potholes, cracks, signs, guardrails & others



Accountability & Audits



Dataset supports **AI training, validation, and periodic model updates**

Patents & Publications

Research-Driven, IP-Secured Innovation

2 Indian Patents Filed & 4* Scientific Papers



Patents filed:

1 **Indian Patent App No. 202411085291** (*Published 13 Dec 2024*)

Title: *Multi-Functional Intelligent Road Asset Monitoring & Assessment System with Integrated IoT*

2 **Indian Patent App No. 202511089592** (*Filed 2025*)

Title: *Single-Camera Pothole Volume/Area Estimation Method*

Publications & Presentations

1 **TRB 2024 – Washington DC**

Augmented Data & Detection Models for Real-Time Road Surveillance

2 **IEEE CONECCT 2024 – IISc Bengaluru**

Anomalous Traffic Sign Detection using YOLOv8 & SAM

3 **CTRG 2025 – IIT Guwahati (Presented)**

Road Anomaly Detection using IMU & GPS Data

4 **TRB 2026 – Washington DC (Presented)**

iRAMA-Net: Edge-AI Framework & Geo-Referenced Road Dataset (Recommended for TRR Publication, Sage Publications)

Our research has been **accepted for national & international conferences**, strengthening technical credibility.

Commercialization Potential

From Research Prototype → Market Deployment



Clients

- PWDs & Urban Local Bodies
- Smart City Agencies & Infrastructure Consultants
- Automotive & Mapping Companies (e.g., Ather, MapMyIndia, etc.)



Business Model

- On-Demand Surveys: city/route specific projects
- SaaS Dashboard (subscription)
- Data Services: download packs & API access



Stage

- **TRL-7** Market-ready prototype
- Field-tested for **800 + km** across diverse urban and highway conditions
- Deployment & support playbooks ready



Core Offerings

Client-specific, geo-tagged & time-stamped road data

Interactive dashboard & automated reports
(pilot-ready)

API integration for pothole alerts & path optimization systems (pilot-ready)

Survey-as-a-Service using Edge-AI device and trained team

Empowering agencies and industries through AI-driven, on-demand road intelligence

Roadmap

Q1 phase started - **Jan 2026** • each quarter = **3 months**.

Q1

- ⑩ Launch iRAMA.AI website & cloud.irama.ai portal
- ⑩ Pilot deployments with partner agencies for testing
- ⑩ Startup Registration

Q2

- ⑩ Distress Quantification + model upgrade: Add Length/Area/Volume
- ⑩ Automated analytics & reporting : ward/zone-wise condition scores

Q3

- ⑩ Production edge device (sealed): pilot batch + remote updates
- ⑩ Unit economics & Pricing finalised: ₹/km survey, device/data subscription

Q4

- ⑩ Crowdsourced fleet: more vehicles > richer, faster road/city coverage
- ⑩ Defect-to-fix app: push tasks > on site action > geo-tagged photo proof

* cloud.irama.ai is live (beta); milestones may overlap based on partner schedules.

Thank You

Digitizing India's Roads for a Safer Tomorrow



Product site - iRAMA.AI



Scan for website

Lab site - SAFETRIP Lab



Scan for lab portfolio

Contact :

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✉ faiz.ce@srice.iitr.ac.in

✉ contact@irama.ai



Backup Slides

Team & ecosystem

Interdisciplinary 4-member core team spanning transportation, AI & IoT



Prof. Indrajit Ghosh (Faculty Advisor)

Professor, Civil Engineering Dept. &
Joint Faculty, Mehta Family School of Data Science and AI, IIT Roorkee
Head, SAFETRIP Lab, IIT Roorkee



Faiz Ali (Venture & IoT Lead)

Project Associate, IIT Roorkee
IoT & edge-AI hardware, system integration (full-time on iRAMA)



Avnish Panwar (AI & Computer Vision Lead)

PhD Scholar, Mehta Family School of Data Science & AI, IIT Roorkee
Detection models & quantification pipeline



Dr. Kaliprasana Muduli (Transportation Domain Lead)

Postdoctoral Fellow, IIT Kharagpur; PhD (Pedestrian Safety using AI, IIT Roorkee)
Road distress area estimation, field trials & validation

Impact & SDG Alignment

Driving Societal Impact through AI & Innovation

INNOVATION | SAFETY | SUSTAINABILITY



AI-based road monitoring enables efficient infrastructure maintenance, supports Make-in-India innovation, and strengthens national mobility systems

Make-in-India AI technology for infrastructure monitoring



Promotes safer, data-driven, and environmentally responsible urban transport networks, helping cities become smarter and more resilient.

Reduced accident risk via proactive maintenance

Lower carbon footprint through optimized road repair

AI-driven road maintenance for safer, greener cities.



Unit Economics – iRAMA Device + SaaS

Cost Drivers

- ❑ **One-time hardware (aprox. Rs. 50k):** edge device, camera, GPS/IMU, screen, casing and vehicle installation
- ❑ **Recurring cloud & software (current aprox. 8k) :** storage, compute, dashboard, APIs, connectivity
- ❑ **Operations & support:** survey runs, field staff, maintenance, and periodic data labelling/model updates

Revenue & Value Drivers

- ❑ **Survey-as-a-Service fees** for a state or city or corridor-specific projects
- ❑ **Data / analytics / API access** for mapping and automotive partners
- ❑ For agencies: **lower effective inspection cost per km** and **better-targeted maintenance**, reducing lifecycle cost
- ❑ **Device + annual software subscription** (per vehicle / per km of network)

Competitive comparison

Why iRAMA vs Existing Approaches

Existing mobile / video survey solutions

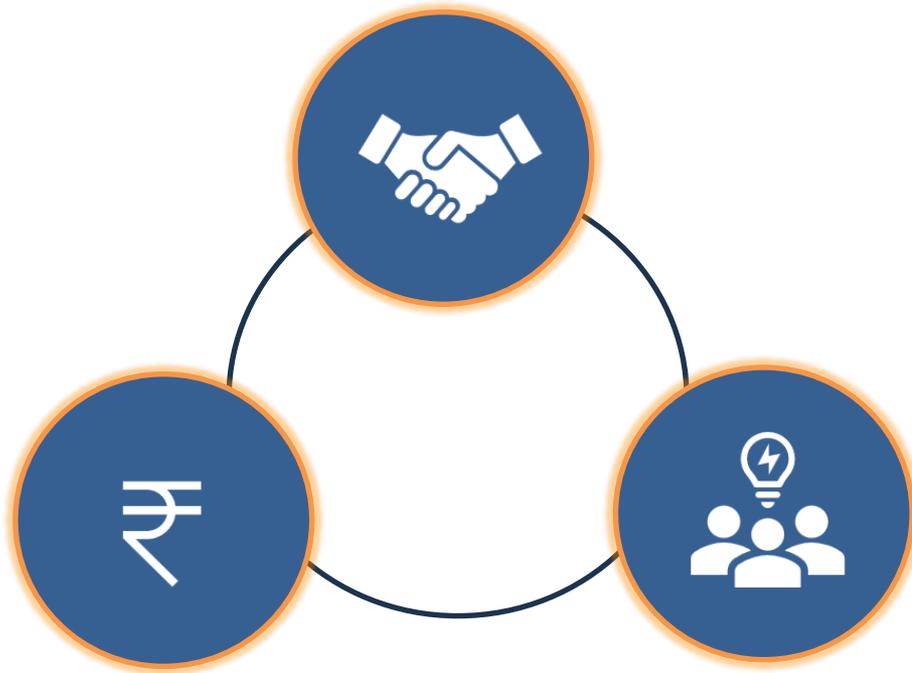
- ❑ Use **mobile or dash cameras to record video**, then do **offline post-survey analysis** in the office
- ❑ **Heavy manual effort**: large technical/analysis team needed to review footage and label events
- ❑ Hard to **scale to an entire state or full network** – processing load grows with every km
- ❑ Outputs are often **PDFs / Excel / raw videos** with **no structured road-wise history or central repo**
- ❑ Higher **cost per km** when coverage increases, because manpower and processing time go up

Our solution – iRAMA.AI

- ❑ **Edge-AI device processes video in real time** on the vehicle; only **geo-tagged events & images** are sent to cloud (complete road map possible)
- ❑ Designed to **scale to full-state networks** – simply add more devices; no huge back-office team needed
- ❑ Can run on **dedicated survey vehicles or fleets** (buses, utility vehicles) and even support **crowdsourced deployments**
- ❑ **Continuous mapping** possible – e.g., with ~10 devices, a fleet can cover **tens of thousands of km in a week** (depending on hours and routes)
- ❑ Data stored as a **structured, geo-referenced road history** with **role-based access**
 - State department can view **state-wide data**
 - Each urban local body sees **only its own area**

Collaborations & Support Sought

TRL 7-8, field-validated and ready to scale



Together, let's digitize India's roads.

We seek

- Launch platform
- Strategic Partners
- Pilots & Deployments
- Manufacturing & Infrastructure
- Recognition
- Market exposure

Patents filed



Office of the Controller General of Patents, Designs & Trade Marks
Department for Promotion of Industry and Internal Trade
Ministry of Commerce & Industry,
Government of India



Application Details

APPLICATION NUMBER	202411085291
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	07/11/2024
APPLICANT NAME	DIVYASAMPARK IHUB ROORKEE FOR DEVICES MATERIALS AND TECHNOLOGY FOUNDATION
TITLE OF INVENTION	A MULTI-FUNCTIONAL INTELLIGENT ROAD ASSET MONITORING AND ASSESSMENT SYSTEM AND METHOD WITH INTEGRATED INTERNET OF THINGS (IOT)
FIELD OF INVENTION	ELECTRONICS
E-MAIL (As Per Record)	srmsvsrr@gmail.com
ADDITIONAL-EMAIL (As Per Record)	
E-MAIL (UPDATED Online)	
PRIORITY DATE	
REQUEST FOR EXAMINATION DATE	03/12/2024
PUBLICATION DATE (U/S 11A)	13/12/2024

Application Status

APPLICATION STATUS	Application Awaiting Examination
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Patents filed



Office of the Controller General of Patents, Designs & Trade Marks
Department for Promotion of Industry and Internal Trade
Ministry of Commerce & Industry,
Government of India



Application Details

APPLICATION NUMBER	202511089592
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	19/09/2025
APPLICANT NAME	DIVYASAMPARK IHUB ROORKEE FOR DEVICES MATERIALS AND TECHNOLOGY FOUNDATION
TITLE OF INVENTION	A REAL-TIME CAMERA-BASED SYSTEM AND METHOD FOR POTHOLE DETECTION, MAPPING AND QUANTIFICATION
FIELD OF INVENTION	COMPUTER SCIENCE
E-MAIL (As Per Record)	srmsvsrr@gmail.com
ADDITIONAL-EMAIL (As Per Record)	
E-MAIL (UPDATED Online)	
PRIORITY DATE	
REQUEST FOR EXAMINATION DATE	26/09/2025
PUBLICATION DATE (U/S 11A)	07/11/2025

Application Status

APPLICATION STATUS

Application Awaiting Examination

Human-in-Loop



Hide Filter

Type: (All Types) From: mm/dd/yyyy To: mm/dd/yyyy Apply Filter Reset

Order: Newest First Jump to SNo: Go Size (W x H): 640 X 480 Apply

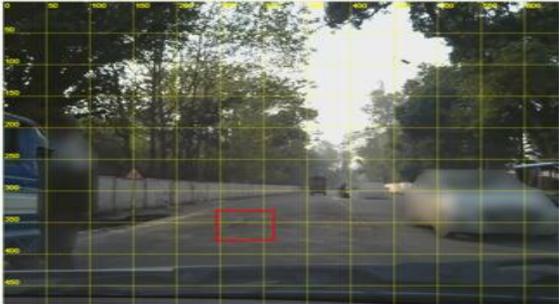
Edit Hide DBox Hide Label Hide More Info Delete



S No	153
Type	Warning-Sign
Details	N/A
Timestamp	2025-01-21 16:05:43
Location	29.856532, 77.887878
DeviceID	IR001
Unique ID	678f8713aac28ba5c883f5
Model Version	v10.1
TL (X,Y)	138.51,260.86
BR (X,Y)	162.75,283.31

- Advertisement Board
- Alligator Crack
- Broken Crash Barrier
- Chevron
- Crash Barrier
- Crosswalk Blur
- Guard Rail
- Hazard-Marker
- Informatory-Sign
- Lateral Crack
- Longitudinal Crack
- Mandatory-Sign
- Manhole
- Pothole**
- Traffic Sign
- Traffic Sign Back
- Warning-Sign
- White Line Blur
- Other
- Pothole

Edit Record



ID: 688d976d792278d956fb61e

Top-Left X: 245.67

Top-Left Y: 331.50

Bottom-Right X: 311.67

Bottom-Right Y: 378.50

Display Yellow Grid

Type: Warning-Sign

Details:

Update Existing Create New Cancel

Show Meta Info

User Dashboard



iRAMA Cloud Dashboard Welcome, Faiz Ali [Logout](#)

Request Data Request History **Approved Data** [Help & Quick Start](#)

Approved Distress Records

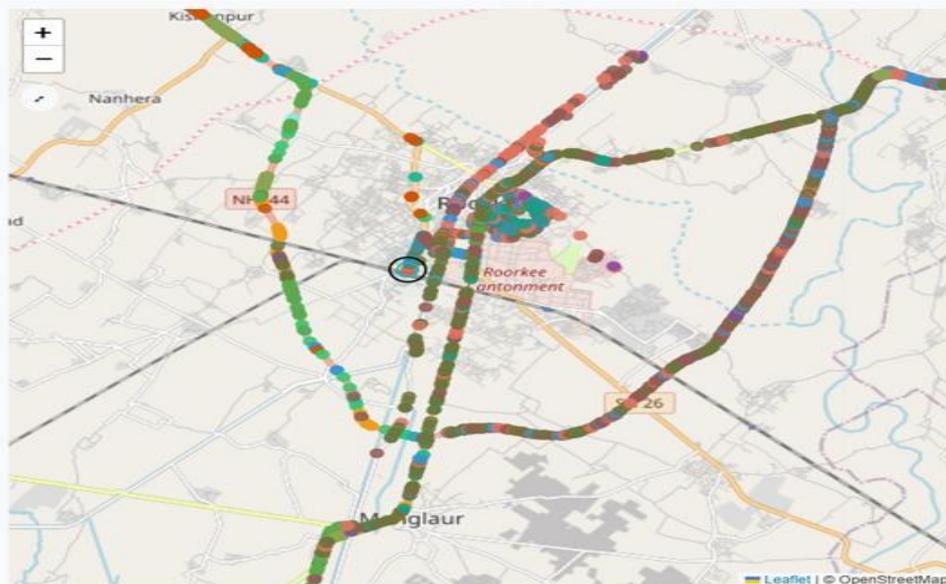
Select Request: REQ-20250929233540-ADMIN - No r... From: mm/dd/yyyy To: mm/dd/yyyy Order: Newest First Items Per Page: 10

Filter by Type: **Pothole** Select types...

Table Image Size: Medium [Hide BBox](#) [Hide Label](#)

Cluster Updated positions Auto-pan Selection Ring (flicker) Basemap: OSM Standard State Boundaries [Legend & Colors](#)

[Apply](#)



Pothole

Type: Pothole
Time: 2025-01-22 08:52:14
Coords Mode: Updated
Location: 29.852979, 77.875461 [Open in Maps ↗](#)
Record ID: 6798b3528fb669c71ac285b4

Specific Data - Area wise



[Request Data](#) [Request History](#) [Approved Data](#)

Request Data

Message:

Enter additional request details...

Data Types:

Advertisement Board Alligator Crack Broken Crash Barrier Chevron Crash Barrier Crosswalk Blur Guard Rail Hazard-Marker

Informatory-Sign Lateral Crack Longitudinal Crack Mandatory-Sign Manhole Pothole Traffic Sign Traffic Sign Back Warning-Sign

White Line Blur

Selected Coordinates (Polygon):

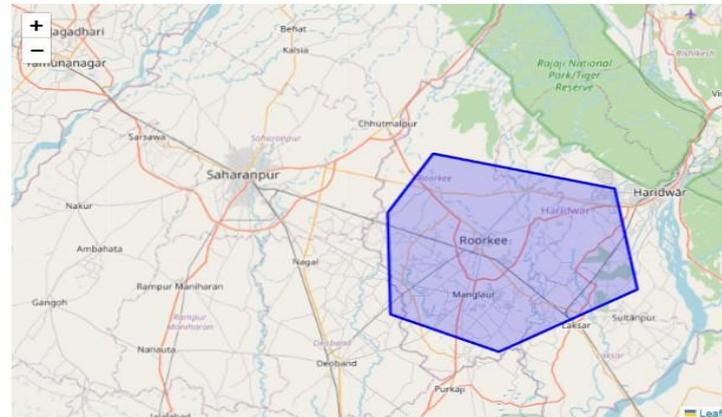
Not set

[Select Coordinates on Map](#)

Select Coordinates

Coordinates:

1. 29.90906848202894, 77.75156357077036
2. 29.993531932820108, 77.81752392184453
3. 29.94354671281044, 78.0799911521604
4. 29.799436288364824, 78.11297132769747
5. 29.71000016138512, 77.91234192651358
6. 29.76364161176537, 77.75568609271248



[Save Location](#) [Reset](#) [Cancel](#)

History of Request



Request Data

Request History

Approved Data

Request History

Sort: Newest First

Request ID: REQ-20250729232345-ADMIN1

Requested on: 2025-07-29 23:23:45

Message: No message

Requested Types: Alligator Crack, Broken Crash Barrier, Chevron, Pothole

Client Coordinates: 29.8992, 77.6672 | 30.0372, 78.0460 | 29.6752, 78.2738 ... [Copy Coordinates](#)

[View Map](#)

Request ID: REQ-20250718170442-ADMIN1

Requested on: 2025-07-18 17:04:42

Message: 44444

Requested Types: Informatory-Sign, Lateral Crack

Client Coordinates: 25.1400, 77.2800 | 23.7800, 83.3900 | 19.9500, 78.7800 [Copy Coordinates](#)

From Admin

Coordinates: 26.9025, 76.8164 | 30.3918, 76.0474 | 30.0501, 80.9033 ... [Copy Coordinates](#)

Status: **Approved**

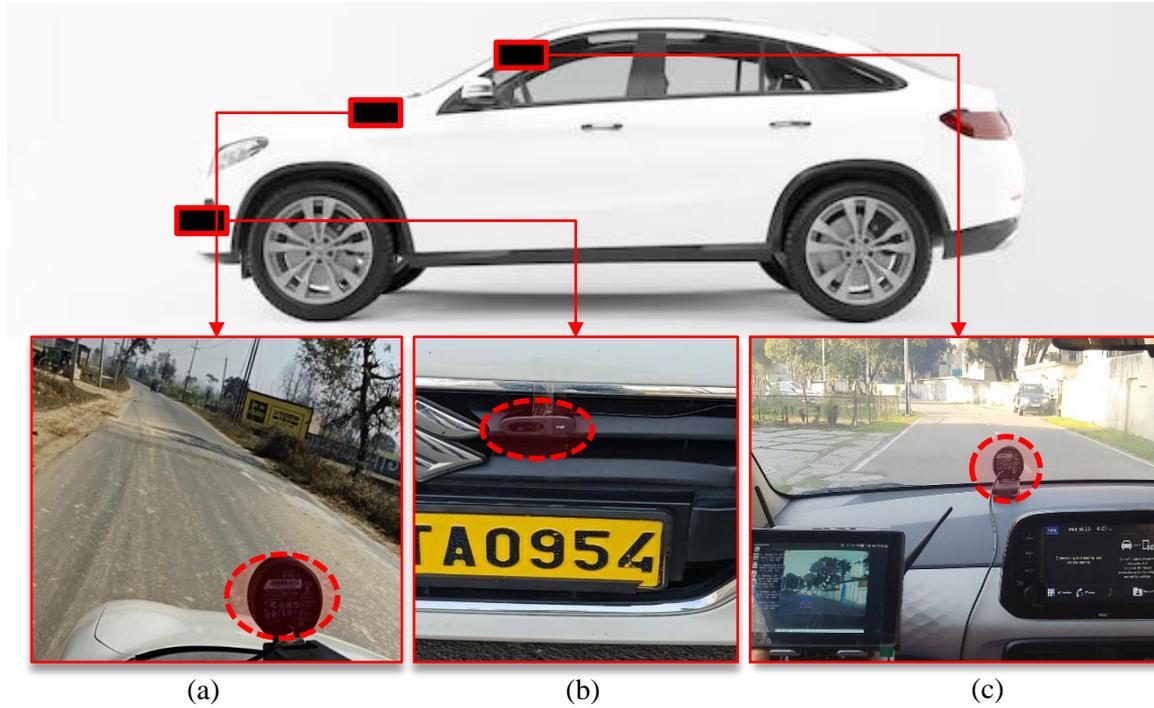
Time: 2025-07-18 20:13:20

Approved Types: Advertisement Board

Note: Request Approved – Work will be completed in 3-4 working days

[View Map](#)

Camera Mounting



GUI - Device

