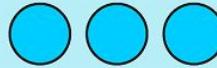




Google Developer Group
On Campus

TechSprint



Leveraging the power of AI



Team Details

- a. Team name: Team Zypher
- b. Team leader name: Thiruvel S
- c. Problem Statement: Open Innovation

PROBLEM STATEMENT AND OUR SOLUTION

Road accidents and traffic disruptions are often caused by unreported or delayed identification of road hazards such as potholes, debris, and damaged infrastructure.

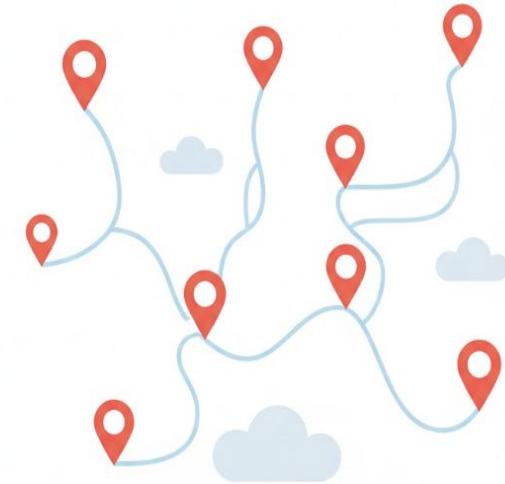
Existing navigation systems rely heavily on manual reporting, making them ineffective for real-time hazard awareness in dynamic urban road conditions.

A **real-time, AI-driven road hazard detection and alerting system** built using **Google Cloud Platform** and **Google Maps Platform**.

Uses computer vision models on **Vertex AI** to automatically detect road hazards from mobile or dashcam video feeds.

Hazards are geotagged, validated, and deduplicated using scalable Google Cloud services.

Confirmed hazards are visualized on Google Maps and proactively alerted to drivers during navigation, enabling safer and smarter route decisions.



Opportunities:

a. How is it different from existing ideas?

- Existing navigation platforms rely on **manual user reports** or delayed updates.
- This system performs **automatic, vision-based hazard detection** in real time.
- Uses **edge + cloud intelligence** to validate and deduplicate hazards, reducing false alerts.
- Integrates directly with **Google Maps Platform**, enabling proactive alerts during navigation rather than passive map markers.
- Designed with **privacy-first processing** (no raw video storage).

b. How does it solve the problem effectively?

- Detects hazards instantly using **AI models on Google Cloud Platform (Vertex AI)**.
- Geotags and clusters multiple reports to confirm real hazards.
- Alerts drivers **before** they encounter the hazard, enabling safer route decisions.
- Continuously improves accuracy as more data is processed, making the system scalable and self-enhancing.

features offered by the solution

- ❖ **End-to-End Automation:** From hazard detection to driver alerts, the entire pipeline operates without manual intervention.
- ❖ **High Accuracy & Reliability:** Vision-based detection combined with cloud-side validation minimizes false positives and duplicate alerts.
- ❖ **Real-Time Responsiveness:** Low-latency processing ensures hazards are identified and communicated to drivers instantly.
- ❖ **Location-Aware Intelligence:** Precise geo-tagging and map integration enable context-aware, route-specific warnings.
- ❖ **Privacy & Security by Design:** Sensitive visual data is processed securely with face and number plate anonymization.
- ❖ **Cloud-Native Scalability:** Serverless architecture allows the system to handle increasing traffic and data volume seamlessly.



Real-Time Detection

Detects potholes, debris, speed breakers & obstructions



Automatic Geo-Tagging

GPS + Google Maps for precise hazard mapping



AI Vision Processing

ML models on Google Cloud (Vertx AI) for accurate detection



Hazard Validation & Deduplication

Clusters multiple reports to avoid spam



Real-Time Alerts

Proactive driver notifications during navigation



Dynamic hazard markers with severity levels on Google Maps



Scalable Cloud Architecture

Face & number plate blurring, no raw video storage

Serverless, auto-scaling backend

Google Technologies used in the solution

1. Google Cloud Platform

- **Vertex AI** – Training and deploying computer vision models for road hazard detection
- **Cloud Run** – Serverless backend for ingesting and processing hazard data
- **Cloud Functions** – Event-driven processing for geo-clustering and hazard validation
- **Firestore** – Real-time storage and synchronization of detected hazards
- **BigQuery** – Analytics, reporting, and hazard trend analysis

2. Google Maps Platform

- **Maps SDK (Web / Mobile)** – Live visualization of detected road hazards
- **Routes API** – Hazard-aware routing and proactive driver alerts
- **Geocoding API** – Precise mapping of hazard locations to road segments
- **Traffic Layer** – Context-aware severity assessment based on traffic conditions

3. Google AI & Privacy Services

- **Vision API** – Face and vehicle number plate blurring for privacy preservation
- **IAM & Secure APIs** – Controlled access and secure communication between services

Process flow diagram



Mock diagrams of the proposed solution (optional):

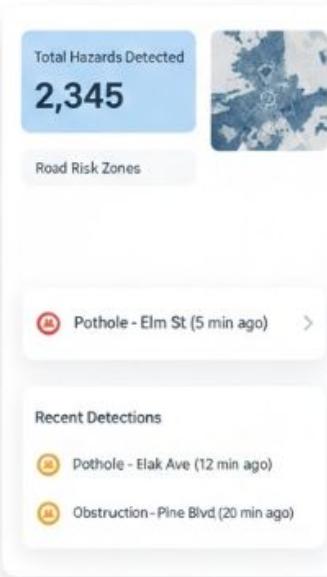
Driver Navigation



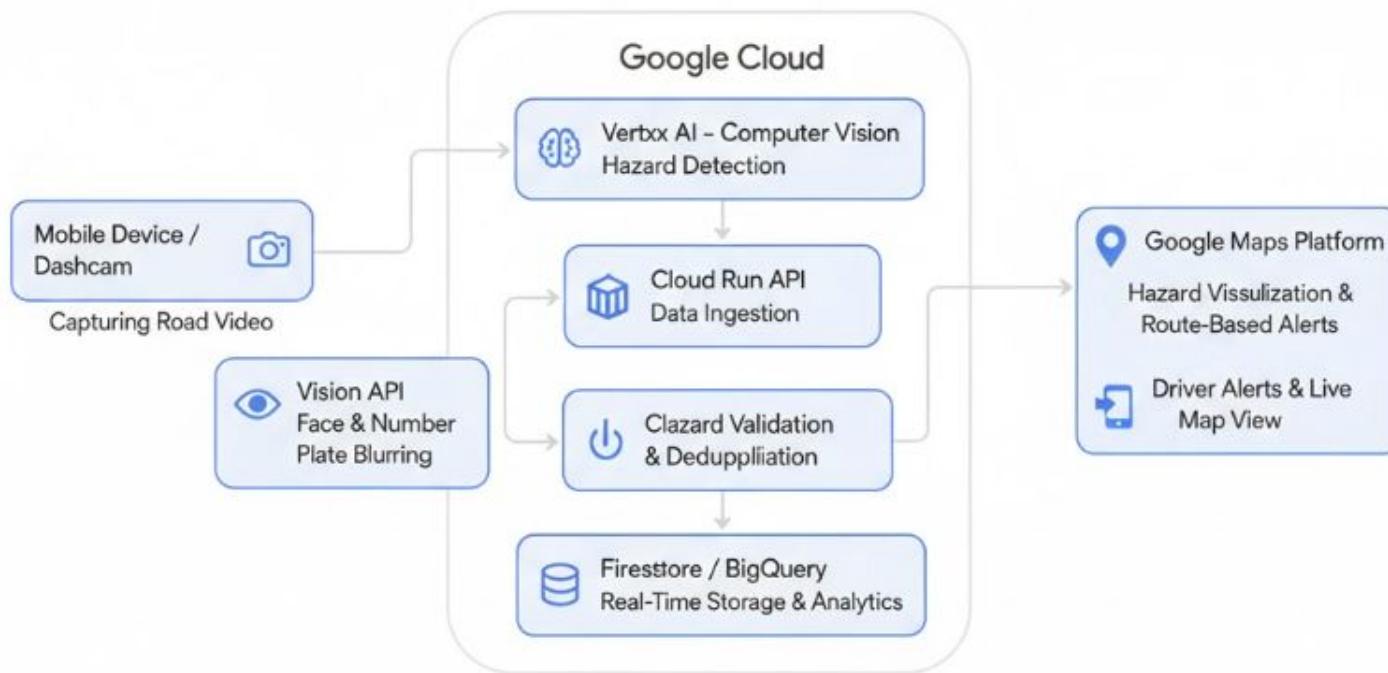
Live Hazard Map



Admin Dashboard



Architecture diagram of the proposed solution



Future Development:

- **Edge-Based Inference Optimization**

Move hazard detection partially to on-device inference for lower latency and reduced cloud dependency.

- **Federated Learning for Model Improvement**

Enable privacy-preserving model updates across devices without sharing raw video data.

- **Predictive Hazard Analysis**

Use historical data to predict high-risk road segments before hazards are reported.

- **Integration with Government & Smart City Systems**

Share real-time hazard data with municipal authorities for faster road maintenance and planning.

- **Multi-Vehicle & IoT Integration**

Extend support to connected vehicles, public transport fleets, and IoT road sensors.

- **Global Scalability & Localization**

Adapt models for different regions, road conditions, and traffic behaviors.



Google Developer Group
On Campus

TechSprint



Leveraging the power of AI



Thank you!

