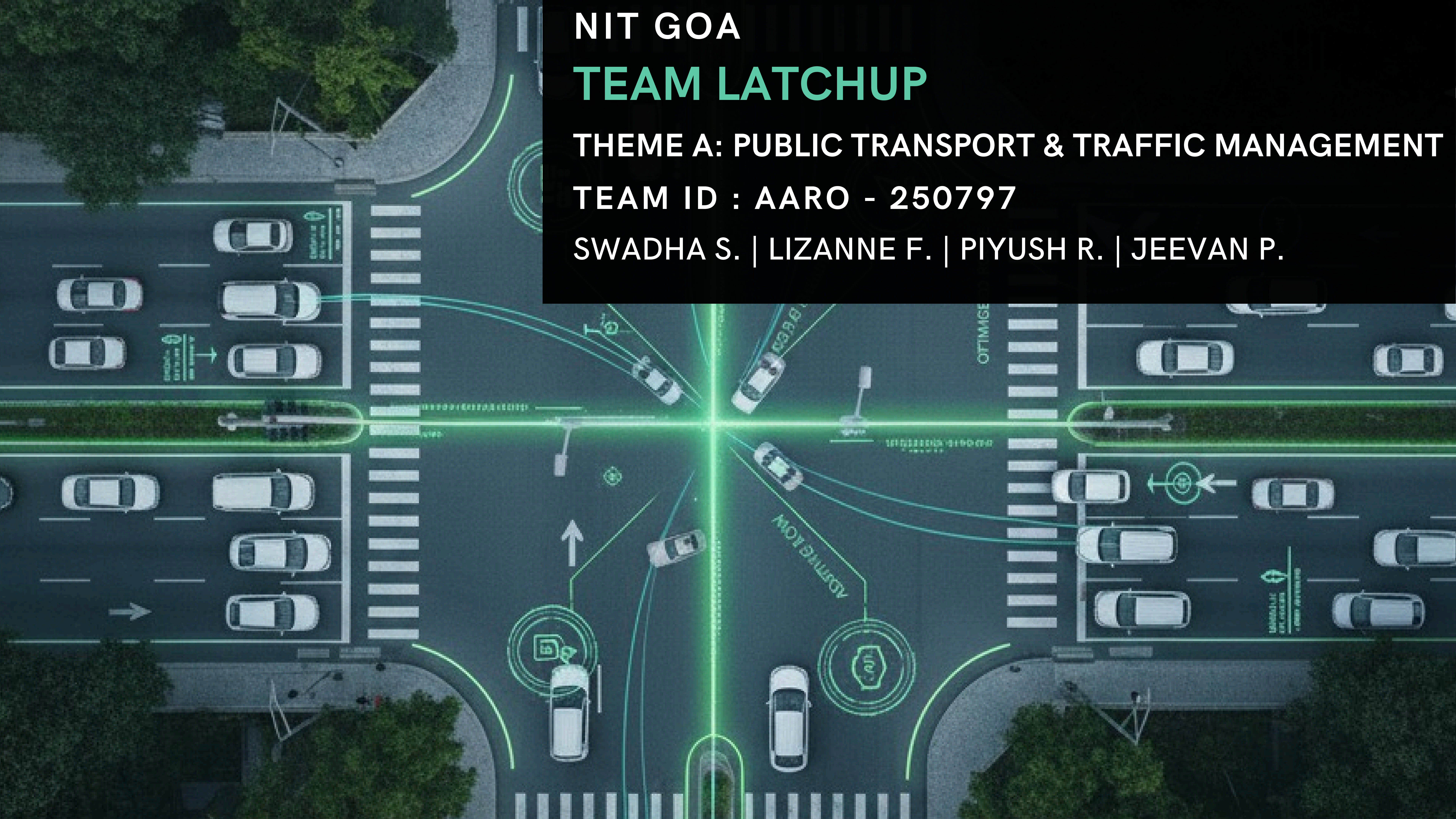

NIT GOA

TEAM LATCHUP

THEME A: PUBLIC TRANSPORT & TRAFFIC MANAGEMENT

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PROBLEM STATEMENT

The Reality: Urban Gridlock

Big cities worldwide, especially in India, are currently paralyzed by severe traffic congestion. This isn't just a minor inconvenience; it is a systemic failure that results in wasted fuel, dangerously high air pollution, and massive loss of productive time for the workforce .

Why Current Systems Fail

- Static & Unresponsive: The primary culprit is that most traffic signals operate on fixed timers that do not change based on actual traffic demand . This leads to frustrating scenarios where a crowded road stays red while an empty lane gets a green light .
- Safety Risks: The inability to manage flow dynamically means ambulances and emergency vehicles frequently get delayed in gridlock, which can risk lives .
- Technological Blindness: Even existing sensors (like road loops) are too basic; they cannot tell how long a line is or what type of vehicles are waiting, making it impossible to ensure fairness or optimize for heavy vehicles like buses .

PROPOSED SOLUTION

Introducing "Drishti": Intelligent & Responsive To solve the chaos of fixed timers, we propose "Drishti," an Adaptive Traffic Control System designed to revolutionize urban traffic management. Instead of following a blind schedule, Drishti uses Computer Vision and Microphones to manage signals in real-time based on actual road demand.

How It Decides:

- The system continuously calculates a "Congestion Score" for every lane and makes decisions based on a strict 3-tier priority logic:

- Emergency Override (Top Priority): If an ambulance is detected via camera, the system grants an immediate green light.

- Starvation Prevention (Fairness): To ensure no driver waits forever, the system guarantees a green light to any lane that has waited beyond a set "Maximum Wait Time".

- Efficiency Optimization (Standard Mode): In normal traffic, it dynamically allocates green light duration to the lane with the highest congestion score to clear queues faster.

TECHNICAL REPORT

TECHNICAL SPECS

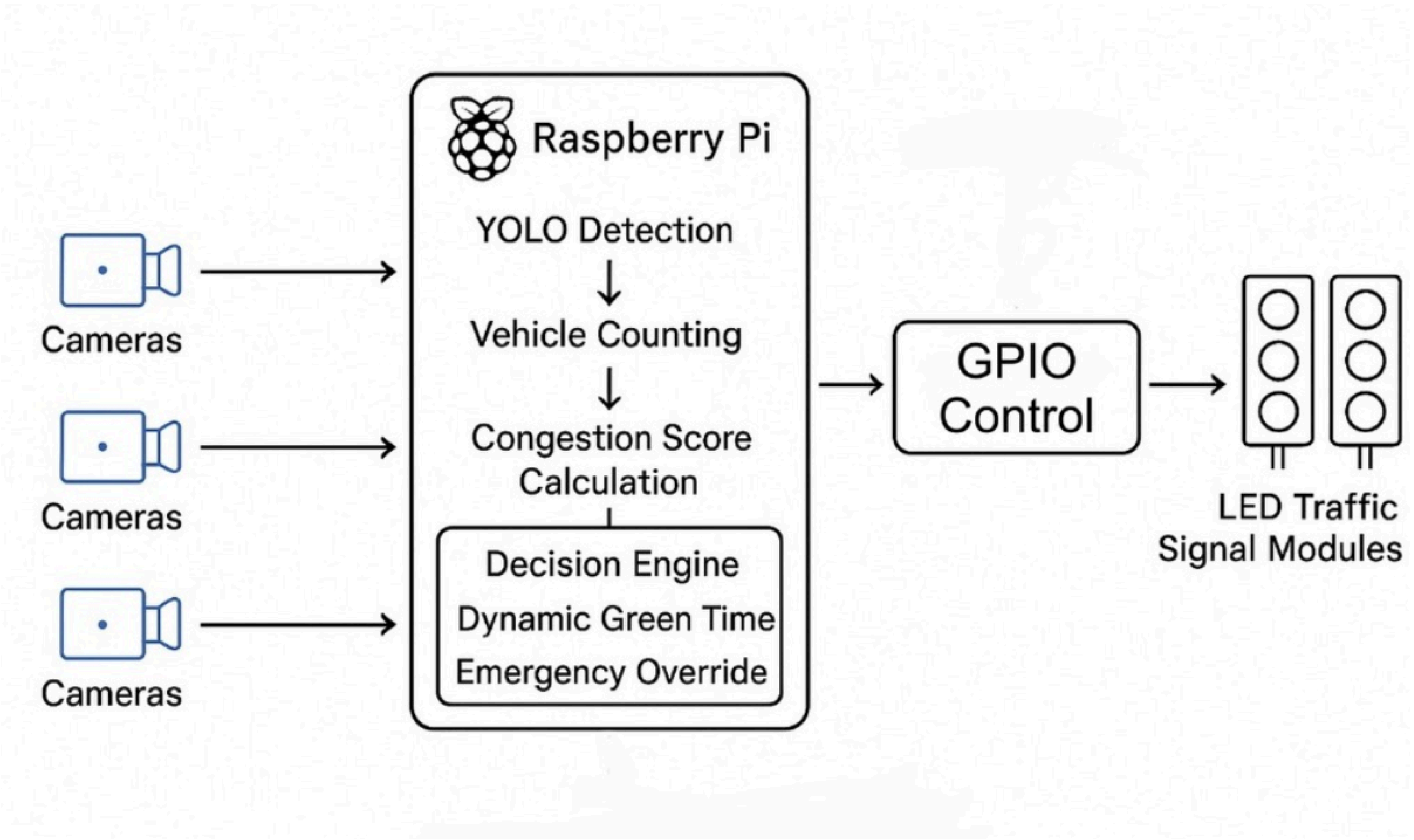
Hardware components

- Raspberry Pi 5
- 3 Cameras
- 3 miniature traffic lights

Software Used

- Yolov8n
- OpenCV
- Python
- ONNX Format

BLOCK DIAGRAM



INNOVATION AND CREATIVITY

Weighted "Congestion Score"

The algorithm calculates a Congestion score that considers the size of vehicles. A lane with 2 buses needs more time than a lane with 2 bikes; Drishti understands this difference, whereas standard sensors do not.

The Fairness Protocol

A major flaw in adaptive systems is that low-traffic lanes get ignored forever. We innovated a "Starvation Prevention" logic that guarantees a green light after a MAX_WAIT_TIME, ensuring equitable access for every citizen regardless of traffic volume.

Creative Retrofitting

Instead of demanding expensive new sensors, Drishti is creatively designed to leverage existing CCTV infrastructure. It upgrades passive surveillance cameras into active traffic managers, making it a sustainable and cost-effective innovation.

Area-Based Volume Detection

Drishti innovates by using Area-Based Detection, where the camera analyzes the entire approach lane. This allows the system to calculate the total queue length and true volume of waiting traffic. The calculation is more precise.

SCALABILITY

Cloud-Ready Ecosystem

The system creates a "Digital Twin" of the city's traffic. The data collected (vehicle counts, congestion times) can be aggregated in the cloud to help city planners model future infrastructure needs, fitting perfectly into the "Smart City" roadmap.

Plug-and-Play Retrofitting (Hardware Scalability)

The system is software-heavy, not hardware-heavy. It is designed to integrate with existing IP cameras already present in many cities. We don't need to dig up roads (like with inductive loops), making deployment rapid and non-intrusive.

Green Corridor" Synchronization

While each node is autonomous, they can be linked to form "Green Corridors." As the system scales, adjacent intersections can share data to create long stretches of green lights for heavy traffic flows during peak hours.

COST AND MARKET VIABILITY

1. COST ADVANTAGE (RETROFIT VS. REPLACE)

- **The Competitor Price Tag:** Traditional adaptive systems like SCATS or SCOOT require heavy infrastructure (underground loops, central servers), costing between ₹20 Lakhs to ₹50 Lakhs per intersection to install .
- **The "Drishti" Edge:** By using a "Retrofit Model"- simply attaching an AI processing unit to **existing** CCTV cameras—we slash installation costs to approximately ₹7.5 Lakhs, a savings of over 60% .
- **No Civil Works:** We eliminate the need to dig up roads to install sensors, further reducing labor costs and public disruption.

2. MARKET DRIVERS: WHY NOW?

- **Rapid Urbanization:** As cities expand faster than road networks can grow, "optimizing flow" is the only viable solution, creating massive demand for intelligent systems.
- **Smart City Initiatives:** Governments are actively shifting budgets toward technology-driven infrastructure upgrades, making this the ideal time for AI-based traffic solutions.
- **Sustainability Mandates:** There is a growing market preference for "Green Tech." Cities are seeking solutions that lower carbon footprints by reducing vehicle idling, aligning Drishti with environmental goals.

IMPLEMENTATION PLAN

Phased & Modular Deployment We propose a low-disruption rollout that prioritizes high-impact areas first, leveraging the system's ability to retrofit existing infrastructure.

1

Phase 1: Survey & Pilot (Hotspot Targeting)

- AI Tuning: Calibrate the YOLO models and microphone sensitivity to accurately detect local emergency siren frequencies and vehicle classes.
- Logic Activation: Enable the "Starvation Prevention" and "Emergency Override" protocols to ensure immediate safety and fairness benefits.

2

Phase 2: Hardware Retrofitting (The "Edge" Layer)

- Non-Invasive Upgrade: Install the AI Processing Units and Microphones at the selected intersections.
- Integration: Connect existing CCTV feeds directly to the Drishti local processor. This allows the intersection to immediately start "thinking" autonomously without needing complex road excavation or central server connection.

3

Phase 3: Calibration & Activation

- Identify Critical Nodes: Select 5-10 high-congestion intersections ("choke points") that already have functional CCTV cameras.
- Baseline Analysis: Collect traffic data to customize the "Congestion Score" parameters for local vehicle types (e.g., density of auto-rickshaws vs. cars).

4

Phase 4: Network Expansion (The "Cloud" Layer)

- City-Wide Connectivity: Once individual nodes are stable, connect them to the central cloud backend.
- Corridor Sync: Use aggregated data to coordinate adjacent signals (e.g., creating a "Green Wave" for peak hours) and provide city planners with predictive models for future infrastructure development.

POTENTIAL OF IMPACT

Significant Social Impact (Quality of Life & Safety)

- Saving Lives (Crucial Priority): By actively detecting and prioritizing ambulances through both vision and audio, Drishti reduces response times in critical situations where every second counts
- Public Health Improvement: Traffic leads to excessive idling, a major source of urban air pollution. By smoothing traffic flow, Drishti directly contributes to cleaner air for pedestrians and residents
- Social Equity & Reduced Stress: The "Starvation Prevention" logic ensures fairness, guaranteeing that commuters on minor roads aren't ignored. This reduces "travel stress" and the potential for road rage

Substantial Economic Impact (Efficiency & Savings)

- Boosted Productivity: Billions of man-hours are currently lost annually to gridlock. By reclaiming this time, Drishti returns productive hours to the workforce, boosting overall economic activity
- Direct Fuel Savings: For individual drivers and fleet operators, reduced idling time at red lights translates directly into lower fuel consumption and costs
- Cost-Effective Infrastructure: By retrofitting existing CCTV networks instead of requiring expensive new ground sensors (like inductive loops or LiDAR), Drishti offers a high-ROI path to "Smart City" status for governments

PROBLEM CENTRIC APPROACH

The Need for Logic vs. The Frustration of "Blind" Waiting

- The User Pain: There is no greater frustration for a driver than sitting at a red light while watching an empty intersecting road. It feels arbitrary and wasteful.
- Drishti's Justification: Our solution directly addresses this cognitive stressor. By using Congestion Scores to dynamically allocate green time, we ensure that if a road is empty, the signal knows to switch, validating the driver's need for logical, efficient flow.

The Need for Fairness vs. The Anxiety of Being Ignored

- The User Pain: In heavy traffic, drivers in smaller lanes often feel "trapped," worried the signal will never favor them over the main road.
- Drishti's Justification: We built a specific "Starvation Prevention" protocol solely to address this equity issue. It guarantees a green light after a MAX_WAIT_TIME, proving the system respects every user's time equally, regardless of their lane's popularity.

The Need for Safety vs. The Helplessness of Delays

- The User Pain: The most critical user need is survival. The panic of seeing an ambulance stuck in gridlock is a failure of public infrastructure.
- Drishti's Justification: We prioritized life over efficiency. Our Emergency Override is a direct empathetic response to this danger, ensuring the system physically clears a path for critical care.