

SuPM 2.0 – Jigyasa Gupta

Product Constraints (Non-Negotiable)

Your teardown must:

- **Real-Time Location Verification** during a hardware failure. It does not attempt to redesign the entire transit app, trip planning, or payment systems.
- Name a **clear user + moment**: The user is Jigyasa, a student standing at a bus stop late at night. The specific moment is when the app displays "Arriving Now" for a bus that physically does not exist due to stale GPS data.
- Identify a **real friction**, not a feature wishlist: The friction is the "Ghost Bus Paradox" - the **erosion of user trust and safety** caused by a system that defaults to a static schedule when it loses a live data connection. This is a fundamental data integrity failure, not a simple request for a new feature or better UI.

Required Deliverables

1 Demo (2–3 mins max) : Video [Link](#)

- Live prototype link: <https://bus-tracker-atoy.onrender.com/>

2 1-Page Product Brief (Hard Limit)

1. Why AI? Product + Flow Chosen:

- We need AI to cross validate multiple sources --> drivers face detection + mobile GPS + movement patterns for a bulk of data that dynamically changes (passengers get on and off)
- Need for intelligent mesh : System maps passenger device telemetry to specific ID/payment method – creating redundant , real-time location mesh that remains active even if the bus scanner or GPS malfunctions.
- Probabilistic Confidence: The agent uses mathematical probability of bus' location and switches UI to "Verified Rider's View" based on active passenger cluster.
- Current bus tracking systems have unreliable GPS that fails. We need AI for validating the location:
 - Bus drivers' Face detection – Sync his data/Mobile GPS to track the bus location – prime evidence – cross check with the bus' existing GPS details. If bus' location GPS does not match driver's location – validate with passenger's GPS. If the driver is away, can raise suspicion alarms for driver's unavailability.
 - Map driver to the passengers – using the payment method/ ID card/Pass used – connect to their device's location – use this for validation – gets updated quickly as passengers get on and off.
 - For cases when the primary hardware for scanning the ID card/payment machine on the bus dies, use passengers' GPS Location to let them receive a check on their device or bus pass. This also saves buses from losses due to malfunctioning hardware.

2. **User & Moment** : Jigyasa, a student standing at the bus stop at night when the tracking app shows that the bus is "now" or the bus departed 2 minutes ago when she had been standing for 20 minutes but no bus shows up.
3. **What's Broken (Evidence / Reasoning)**: In case of no show of buses, bus tracking app receives "No data" or "Old data" because of which the app reflects the scheduled time. Mere hardware failure or no maintenance, erodes user's trust.
4. **Your Rebuilt AI Experience**: A truth seeking agent that checks for the bus location. Whether the location is available or missing, it validates the location using a multi-modal mesh of passenger data. If the hardware malfunctions, bus will show "Verified rider's view"
5. **Where AI Fits (specific model / agent role)**: A Reasoning Agent (with LLM logic) – consumes hardware pings + passenger/driver's movement patterns to determine probability of bus's location coordinates.
6. **One Tradeoff You Accepted**: Privacy vs Precision , to verify the bus via mesh, we need a more aggressive background location sampling from riders that opt-in than a regular tracking app.
7. **One Risk You're Worried About**: Low occupancy is a tricky case to handle in terms of validation. While the driver's location is instrumental, an empty bus means there's barely any other way to verify which could mean slightly less confidence in predicted location for the first rider.
8. **Metrics and next steps** : The final change on the app would be a "vibe check" button to check for location and "Onboard" button (optional) for the users – to boost agent's confidence. This will reduce atleast 30% less missing buses which tracking apps don't track.

Bonus (Optional, High Signal)

- Agent logic:

1. The Multi-Modal Input Layer

- The agent simultaneously monitors three primary evidence feeds to build situational awareness:
- **Hardware Layer:** Standard binary GPS pings from the bus.
- **Driver Layer (Prime Evidence):** Validates the "human element" via driver face detection and mobile GPS pings.
- **Passenger Mesh Layer:** Collects anonymized telemetry (velocity and route vector) from opted-in rider devices.

2. Weighted Reasoning Logic

- The core engine applies a **weighted decision matrix** to resolve data conflicts:

Source	Reliability Weight	Role in Reasoning
Bus Hardware GPS	100% (High)	Primary truth; if active, location is absolute.
Driver Mobile/Face	70% (Medium)	Proves vehicle motion and driver presence if hardware fails.
Passenger Mesh	30% (Variable)	Acts as a redundant "vibe check"; grows with more riders.

3. The Decision Gate (Conflict Resolution)

When signals disagree, the agent executes a three-step resolution loop:

- **Trigger:** If bus_gps is OFFLINE, initiate a "Truth-Seeker" sweep.
- **Cross-Validation:** Check driver_verified AND passenger_count.
- **>= 80% Confidence:** Both driver and ≥ 3 passengers match the route; render "Verified by Mesh."
- **40-70% Confidence:** Only driver or single passenger detected; render "Probable Location."

- **Default:** If no signals match, drop to **<10% confidence** and trigger a "Ghost Bus Alert".
- Why you didn't use ML vs rules (or vice versa)
 - The Agent uses Deterministic Logic for the math (Weighting) but LLM-based Reasoning for the context.
 - **Pattern Recognition:** The Agent doesn't just see coordinates; it "reasons" about the cluster. It asks: "Is it likely that 5 people are moving at 20mph in a perfect line if there is no bus?".
 - **Dynamic Feedback:** Unlike a static model, the agent can process natural language "Vibe Checks" from riders and update its confidence score instantly.
 - **Transparency:** It provides the "Verified Rider's View" label, explaining to the user exactly how it reached its conclusion (e.g., "Verified by 5 passengers"), which builds the trust that ML/Rules lack.
- Cost / latency / trust considerations

To maintain trust of users, use of anonymized telemetry to ensure that while the group's movement is tracked, Jigyasa's individual identity is never compromised.