The Morse Protocol

An Optical, Peer-to-Peer V2V System for Drunk Driving Prevention

The Critical Blind Spot in Modern Vehicle Safety

Every year, thousands of lives are lost to drunk driving accidents.

While modern vehicles are equipped with advanced safety systems to protect their occupants, they lack a crucial capability: the ability to warn *other drivers* of an immediate, driver-induced danger in real-time.

We treat the symptom (the crash) but not the active threat.

Over **30%** of all traffic-related deaths in the U.S. involve a drunk driver.

The Engineering Challenge: How Do We Broadcast a Real-Time, Localized Danger Warning?

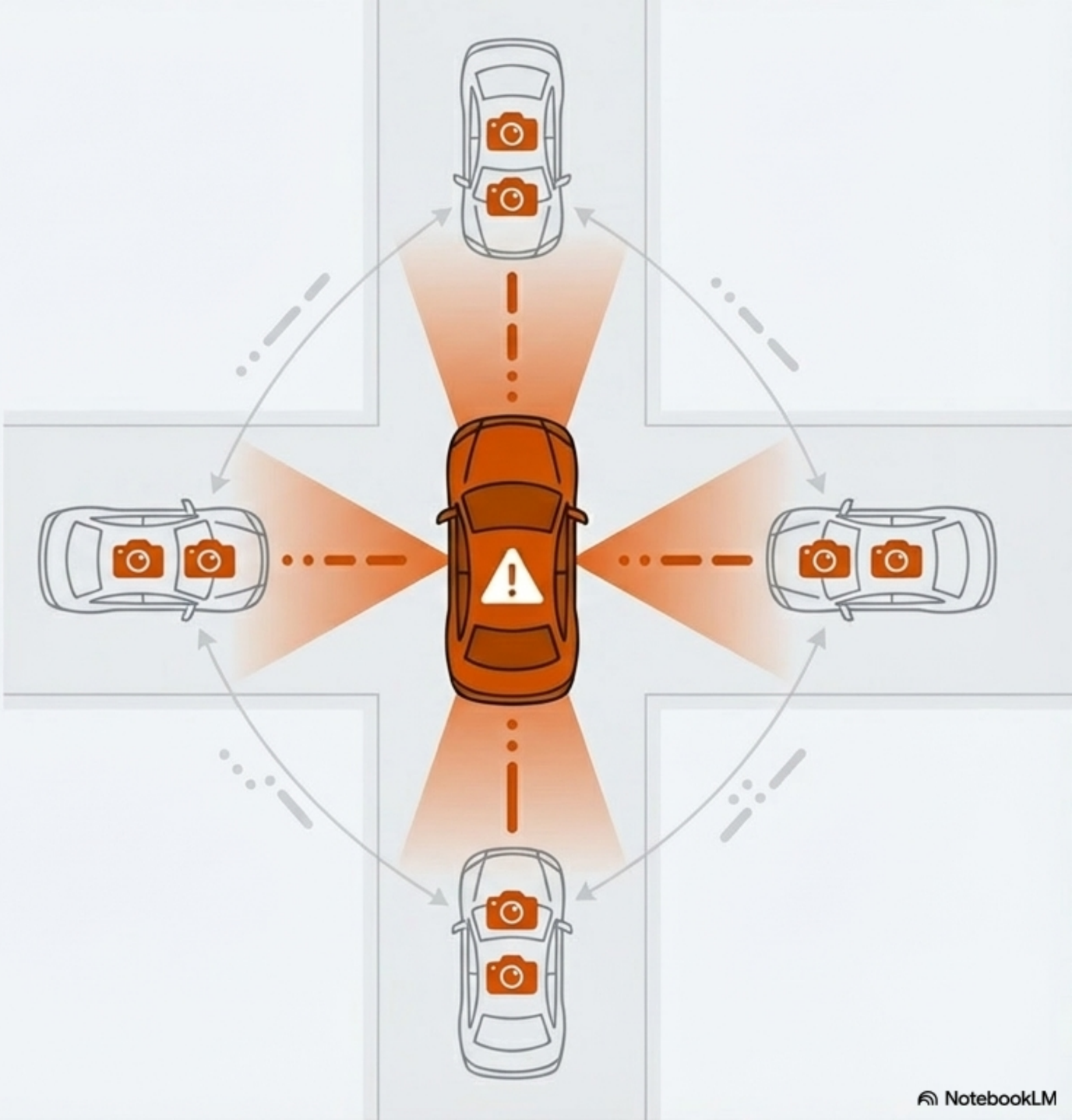
The problem requires a decentralized, immediate, and universally understandable signal.

Existing V2V solutions based on DSRC or 5G are complex, expensive, and suffer from low adoption rates.

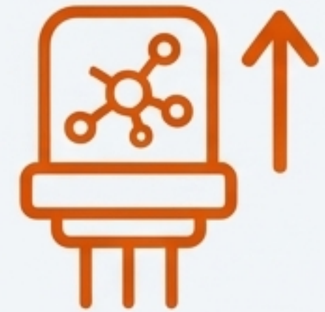
We need a system that can be deployed now, using infrastructure that already exists on nearly every vehicle on the road.

Our Solution: The Morse Protocol

A system that enables a vehicle to autonomously detect driver impairment and communicate a clear warning to surrounding traffic using its existing external lights. It transforms a vehicle's lights into a low-bandwidth, high-impact safety beacon.



Step 1: High-Confidence Impairment Detection

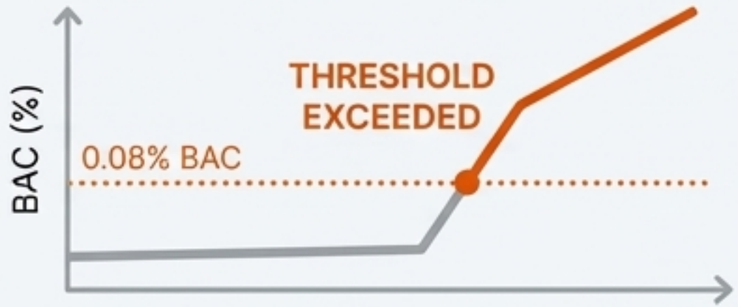


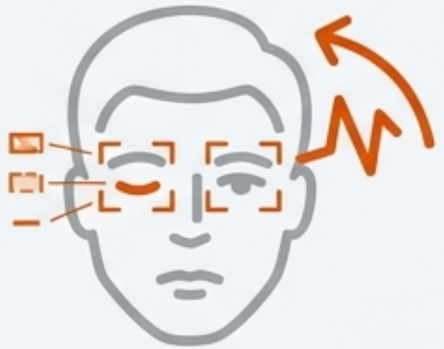
Biometric Sensing

An MQ-3 alcohol sensor measures the driver's Breath Alcohol Concentration (BAC) in real-time. A reading above the legal threshold (e.g., 0.08%) serves as the initial trigger.

Behavioral Analysis

A cabin-facing camera uses computer vision algorithms (OpenCV/TensorFlow) to detect physical signs of intoxication, such as droopy eyes, erratic head movements, or changes in posture.





An alert is only activated when both sensor and visual data correlate to indicate a high probability of impairment.

The Medium is the Message: Why Morse Code?

Upon confirming impairment, the system doesn't rely on complex radio signals. It uses a universal, time-tested encoding standard: Morse code. The vehicle's lights (headlights, hazards) blink a pre-defined message (e.g., "DANGER" or "DRUNK DRIVER") in a continuous loop.

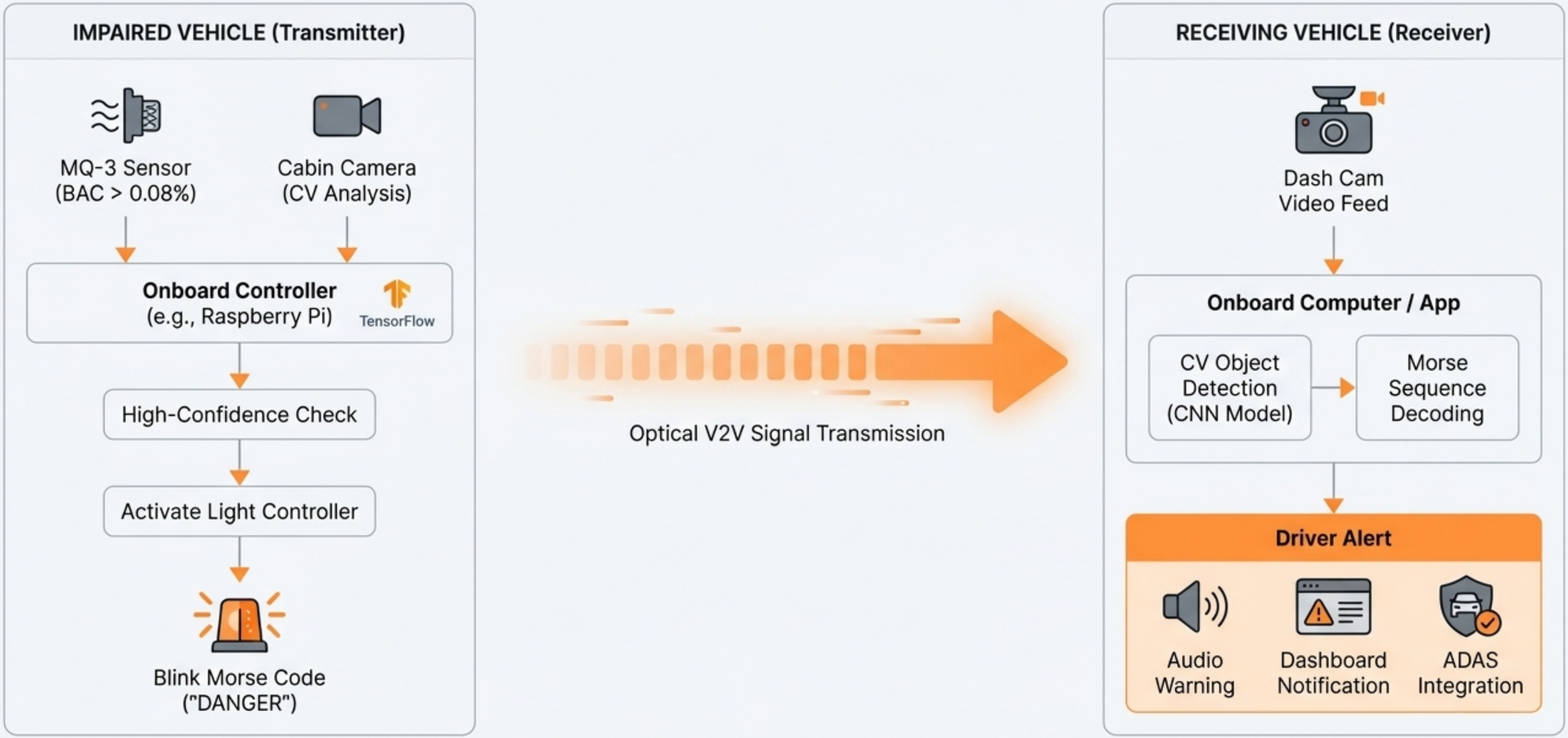
- **Universal:** A standard, decodable by simple algorithms.
- **Low-Tech & Robust:** Uses existing hardware (lights, relays). No new network required.
- **Unambiguous:** The rhythmic pattern is distinct from normal light functions or random flickering.

Step 2: Peer-to-Peer Decoding and Alerting

Any nearby vehicle with a standard dash cam or rear-facing camera can act as a receiver. An ML-assisted algorithm running on the receiving vehicle's onboard system continuously processes the video feed.

1. **Identify:** A computer vision model detects the anomalous, rhythmic blinking of a vehicle's lights.
2. **Decode:** A sequence model translates the pattern of short and long blinks from Morse code into a text message in real-time.
3. **Alert:** The receiving driver is immediately notified via an audio warning or a dashboard notification, allowing them to increase their distance or take evasive action.

The Morse Protocol: End-to-End System Architecture



A Practical, Accessible, and Effective V2V Solution

Low Cost & Retrofittable

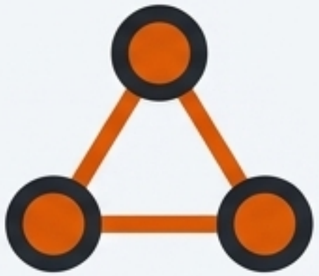
Utilizes off-the-shelf sensors and existing vehicle hardware (lights, cameras), making it easy to install in new and existing cars.

Universal & Network-Independent

Works without reliance on complex, proprietary networks like DSRC or 5G, ensuring functionality anywhere, anytime.

Privacy-Preserving by Design

Communication is anonymous. No personally identifiable data is transmitted—only a universal warning signal.



Decentralized and Resilient

A true peer-to-peer system that operates independently, without need for a central server or external infrastructure.

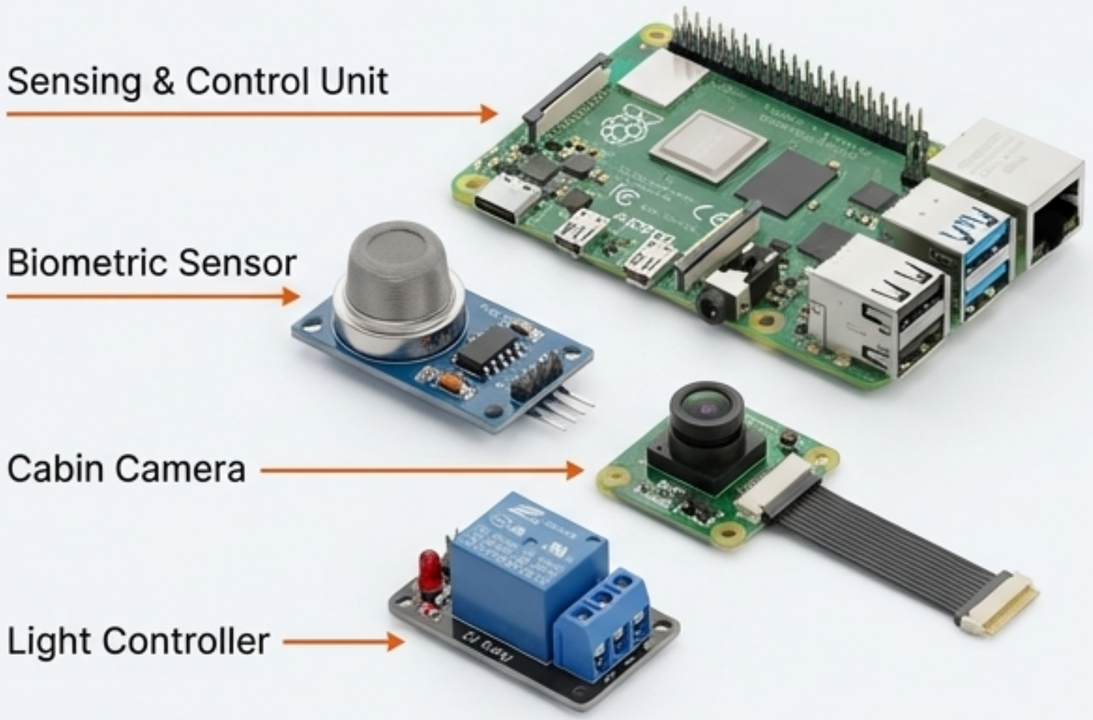
Addressing Real-World Challenges and Mitigations

Challenge	Mitigation
Environmental Interference How do bright sunlight, heavy rain, or fog affect the optical detection of the signal?	**Robust ML Models** Train detection algorithms on vast datasets of diverse weather and lighting conditions to ensure high accuracy.
False Alerts (External) How to differentiate the signal from other flashing lights (e.g., emergency vehicles, broken lights)?	**Unique Signal Signature** The specific rhythm and consistency of the Morse code pattern can be distinguished from erratic flickering by the decoding algorithm.
Legal & Ethical What are the implications of a system that publicly labels a driver?	**Phased Implementation** Initial rollout could be an anonymous "DANGER AHEAD" signal, not a specific accusation. Focus is on safety, not enforcement.

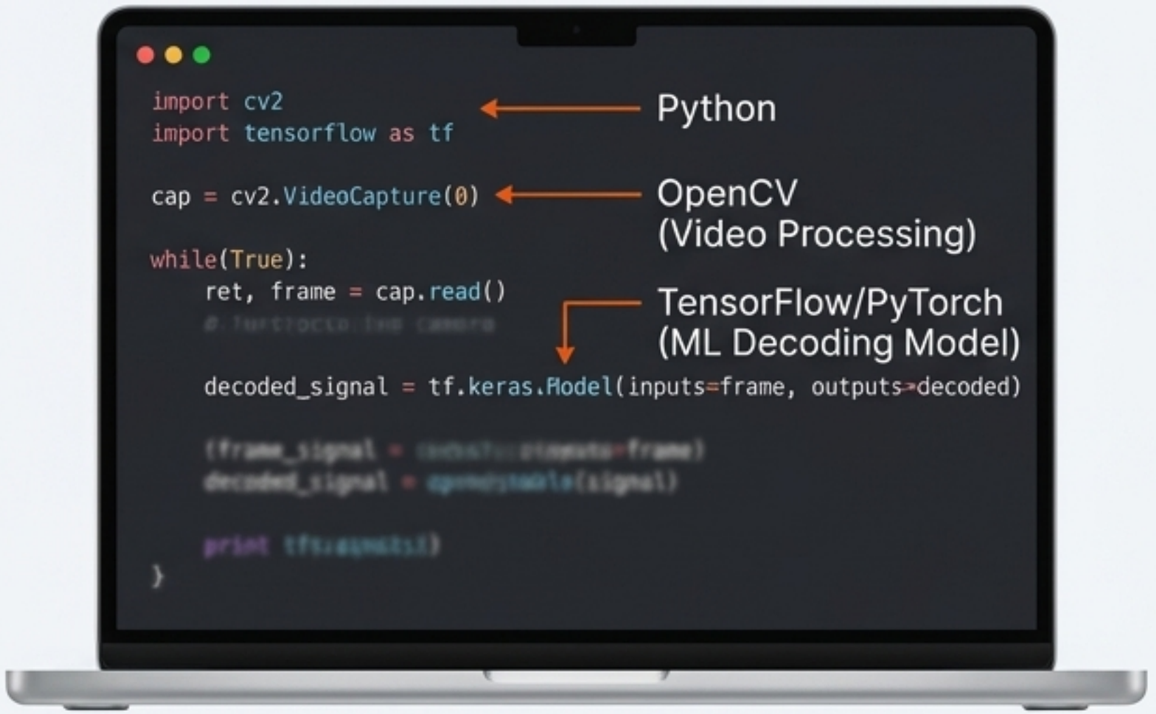
The Path from Concept to Prototype

The Morse Protocol is designed for rapid and cost-effective prototyping. The core components are readily available and widely used in the engineering community.

Key Components for a Proof-of-Concept:



Decoding Unit & Software



This architecture allows for iterative development and testing, making a functional prototype an immediate and achievable next step.

Transforming Every Headlight into a Lifesaving Beacon

The Morse Protocol is more than an alert system; it's a fundamental shift in vehicle safety. By leveraging existing infrastructure with intelligent, elegant technology, we can create a decentralized network where every vehicle actively contributes to the safety of all others on the road.