GROUP 2

Introducing SentinelDrive

DRIVER-SAFETY SUITE WITH VOICE-INTERACTIVE, BLIND-SPOT ASSISTANCE AND CONTEXT-AWARE AI INTEGRATION

Problem Statement

Primary Issue:

Blind spots in vehicles significantly contribute to road accidents, especially during lane changes or turns.
People generally drive negligently, **ignoring ORVMs** and blind spots before turning, potentially leading to collisions with approaching vehicles.

Impact:

- Increased risk of collisions with vehicles, cyclists, and pedestrians, approaching from behind.
- Heightened stress and reduced safety perception for drivers.

ORVM & BLIND SPOT NEGLIGENCE CAUSED

1,543

FATAL ACCIDENTS, EACH YEAR IN USA
THIS YEAR.

Overview: System Operation

Steering Detection

Computer vision based program to judge if the driver is turning left or right. Arduino registers these signals instantly.

Object Detection:

Ultrasonic sensors placed strategically around the vehicle measure distance continuously.

Alert Generation:

Arduino activates buzzer alerts if turning and object detection conditions are simultaneously met.

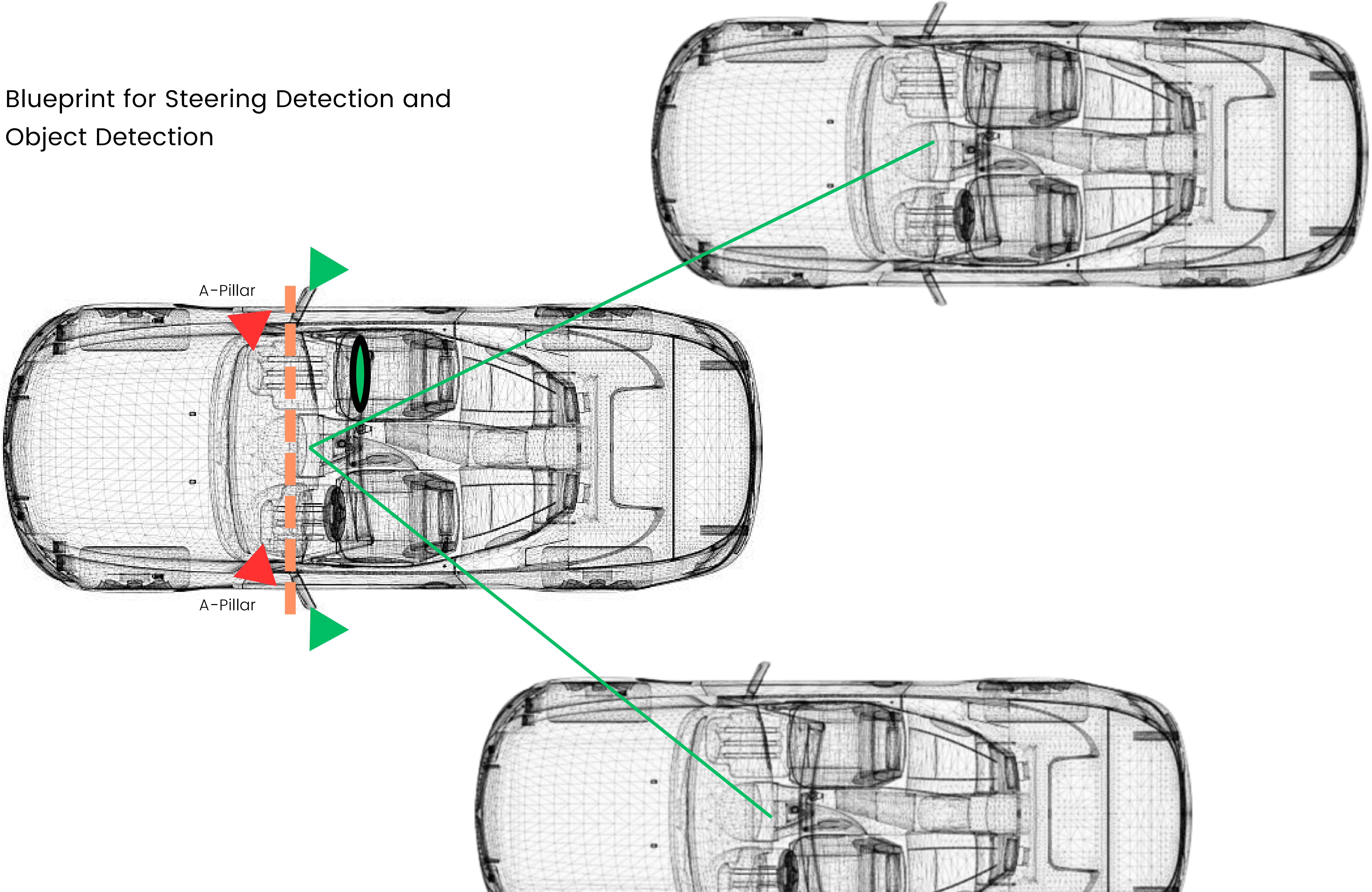
Voice Command Recognition

Microphone captures user's voice and activates command mode using wake-word detection ("gogi").

LLM-Driven Suggestions

Context-aware prompts are sent to a local Mistral model via Ollama to generate safety tips in real-time.

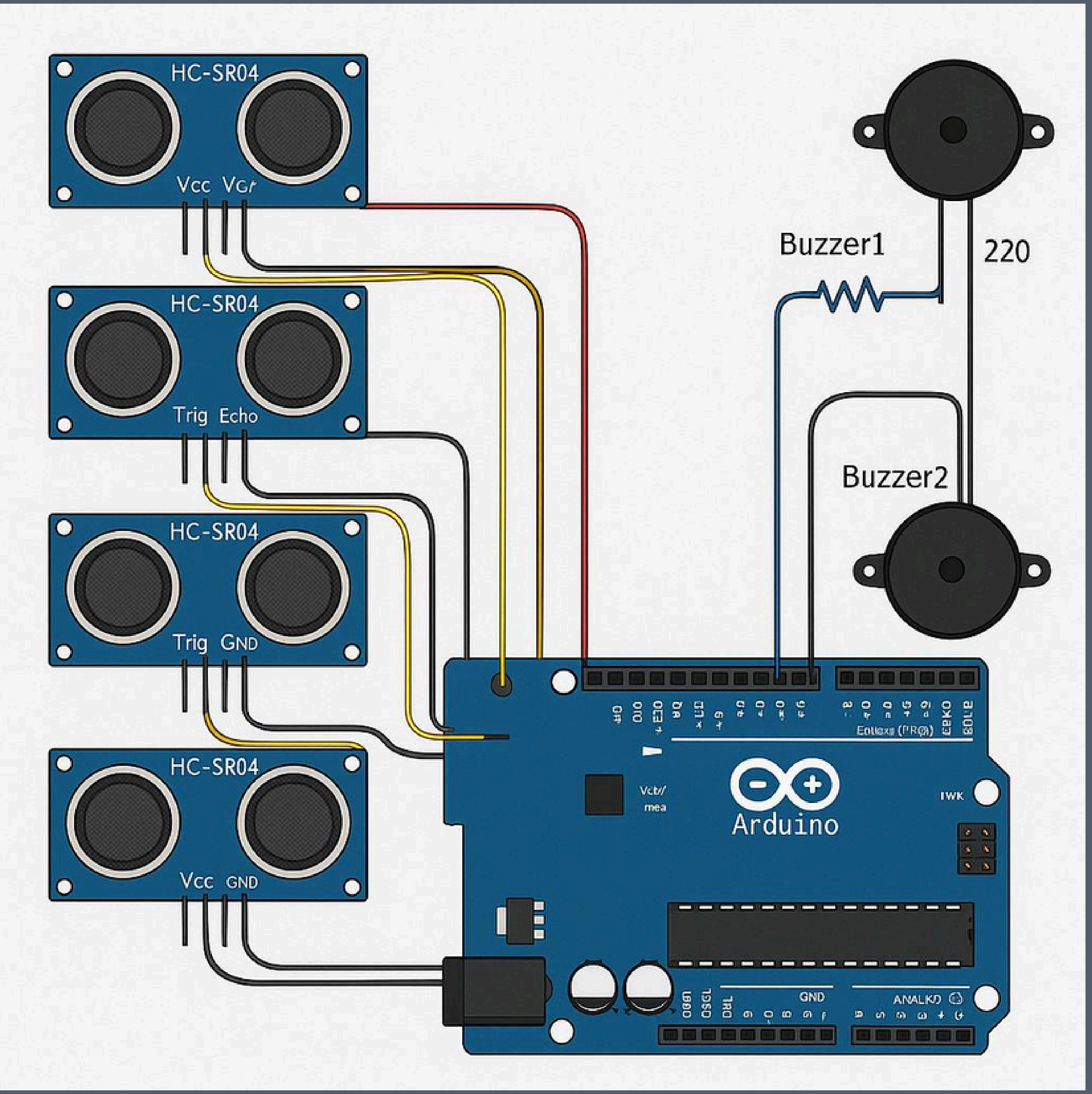
Blueprint for Steering Detection and Object Detection



Computer Vision Module

- **Steering Detection:** Trained on labeled video data using HSV tracking for neon-green stickers.
- **Drowsiness Detection:** Eye-Aspect Ratio (EAR) < 0.18 over 2 seconds, validated against labeled eye-closure data.
- **Drunk/Unwell Detection:** Head-bow detection > 1.5s or RMS shake > 60px over 3s, trained on annotated motion datasets.
- **Stress Detection:** Vosk keyword spotting, including custom-trained keyword models, and amplitude-based shouting detection.

Arduino-Based Blind Spot Monitoring



- 4 Ultrasonic sensors (2 on each side) detect nearby obstacles.
- Distances are read every 500ms.
- If a turn signal is detected (LEFT/RIGHT) and proximity condition is met, corresponding buzzer is activated.
- Ensures blind-spot safety during turns.
- Steering and Obstacle Alert Logic
- Commands like LEFT, RIGHT, or STEER:LEFT trigger respective checks.
- If distance < 100 cm on corresponding side → buzzer alert activated.
- Alerts only fire when both steering and proximity conditions are met, reducing false positives.

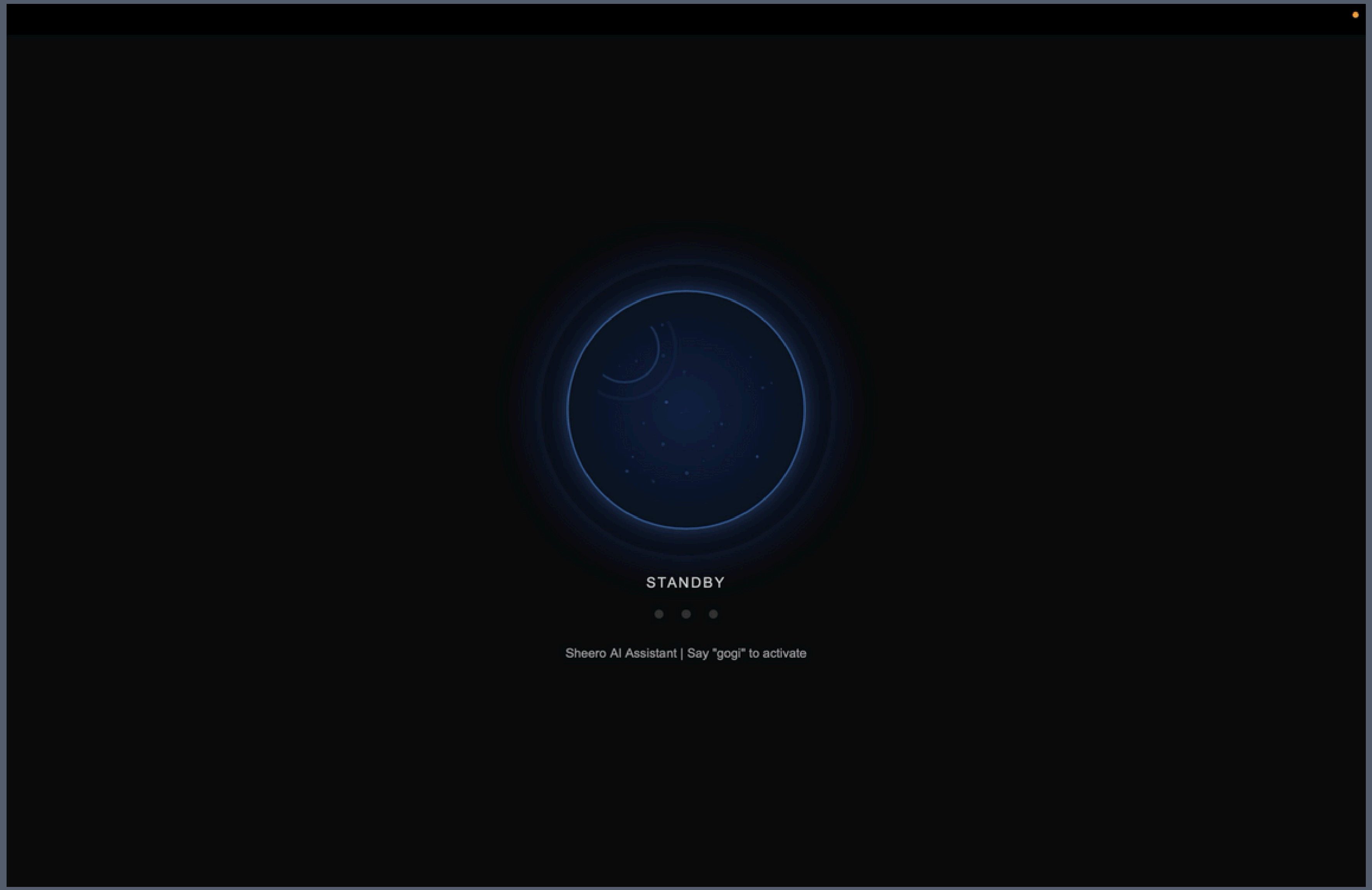
Smart AI Assistant for In-Vehicle Safety & Comfort

- Voice-Activated Assistant ("gogi")
- Multimodal Alert Monitoring: Drowsiness, Drunkenness, Stress
- Real-time Suggestions & Response
- Context-aware
- Integration with Ollama (LLM backend)

Safety Monitoring Engine

- Driver State Tracking
- DROWSY, DRUNK, STRESS, STEER, CRASH
- Time-windowed alerts with cooldowns
- Real-time intervention if thresholds exceeded
- Uses lightweight TTS + LLM (Mistral via Ollama)

- Wake Word Detection: "gogi"
- Listening Phase: Captures user query
- Response Generation:
    a. Simple command → predefined responses (music, weather)
    b. Open-ended → sent to Ollama LLM



Real-Time Dashboard UI

- Dashboard shows assistant mode (Standby, Listening, Speaking)
- Live alert indicators for drowsiness, drunk, and stress
- Web interface built using Flask and HTML/CSS/JS
- Real-time state updates pushed via REST API

Aspects of Ubiquitous Computing in Solution

Adaptability

Modular design suitable for integration into various vehicle types and environments.

Context Awareness

Real-time response to environmental changes (vehicle movements, Driver's activities and surrounding objects).

Low Intrusiveness

Non-obstructive system integration ensuring minimal disruption to driver experience.

System Design

Seamless integration into daily driving without noticeable interference.

Sensors and Actuators

Use of ultrasonic sensors and electrical actuators to create responsive safety mechanisms.

ITERATIVE EXPERIMENTATION FOLLOWING THE DEVELOPMENT OF THE BASELINE MODEL.

Integration of Advanced Sensors

LiDAR or camera-based vision systems for improved accuracy.

Machine Learning Integration

Real-time response to environmental changes (vehicle movements and surrounding objects).

Cloud Connectivity

Non-obstructive system integration ensuring minimal disruption to driver experience.

Open to Questions!

Thank You