Team Name : Virtus Synergie

Problem Statement : AI-Enhanced Driver Wellness Monitoring

5 Things to Know

- ❑ **What is the Problem?**
- ❑ **What is Our Solution?**
- ❑ **Why is Our Idea Better (The Opportunity/USP)?**
- ❑ **What are the Features?**
- ❑ **How Does it All Fit Together (The Architecture)?**

Problem

The core problem we are solving is the high number of road accidents caused by **driver impairment**. This isn't just one thing; it's a combination of:

- **Fatigue:** Drowsiness, microsleep, and yawning.
- **Distraction:** Looking away from the road or using a mobile phone.
- **Stress & Medical Events:** Sudden health issues like a heart attack or stroke that can incapacitate a driver.

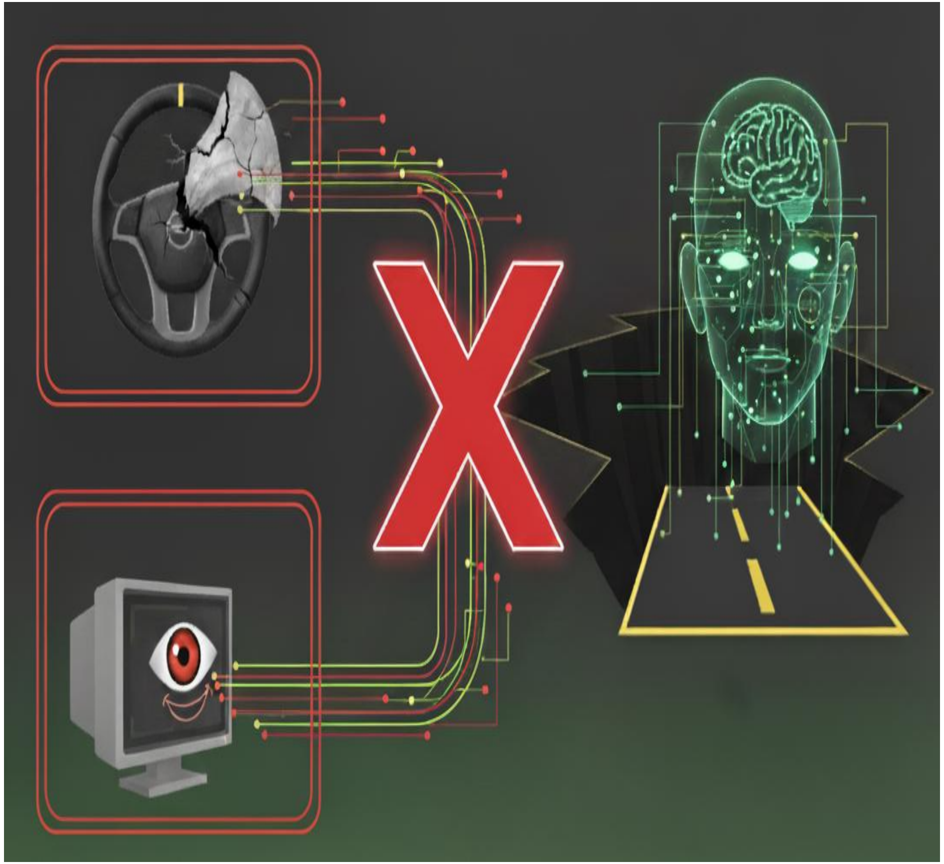
Traditional safety systems are often reactive (like airbags) or single-focused (like a simple drowsiness alert). They fail to see the complete picture of the driver's wellness

The Gap in Current Solutions

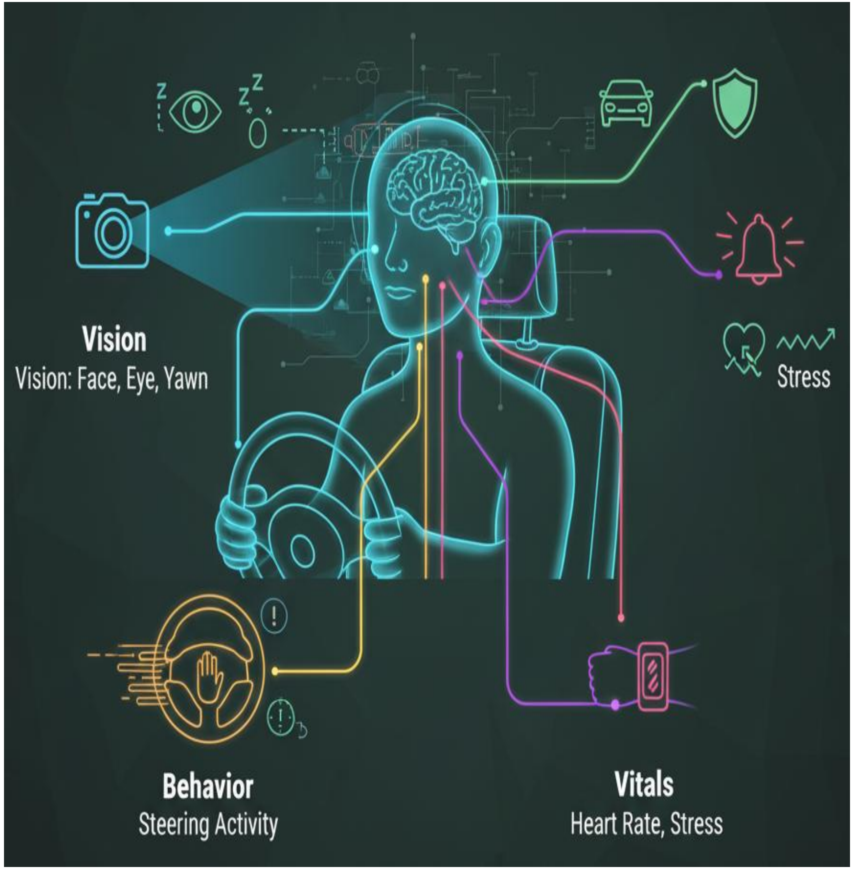
You might think, 'Don't cars already have safety systems?' And they do. But traditional systems are fundamentally flawed.

They are reactive like airbags, which only help after a crash has already happened.

Or, they are single-focused like a simple drowsiness alert that can be easily fooled. They fail to see the complete picture of the driver's wellness. This is the dangerous gap we are filling.



Our Solution: The AI-Powered Co-Pilot



Our solution is a privacy-first, multi-modal AI co-pilot that monitors the driver's state in real-time.

It's 'multi-modal' because it doesn't just rely on one data source. Instead, it intelligently fuses three complementary streams to make a more accurate decision:

Vision: A camera tracks facial landmarks to detect eye closure, gaze, and yawning.

Behavior: A steering wheel sensor monitors activity to identify erratic driving or, just as importantly, a lack of driver input.

Vitals: The system integrates with a wearable to measure heart rate and stress indicators.

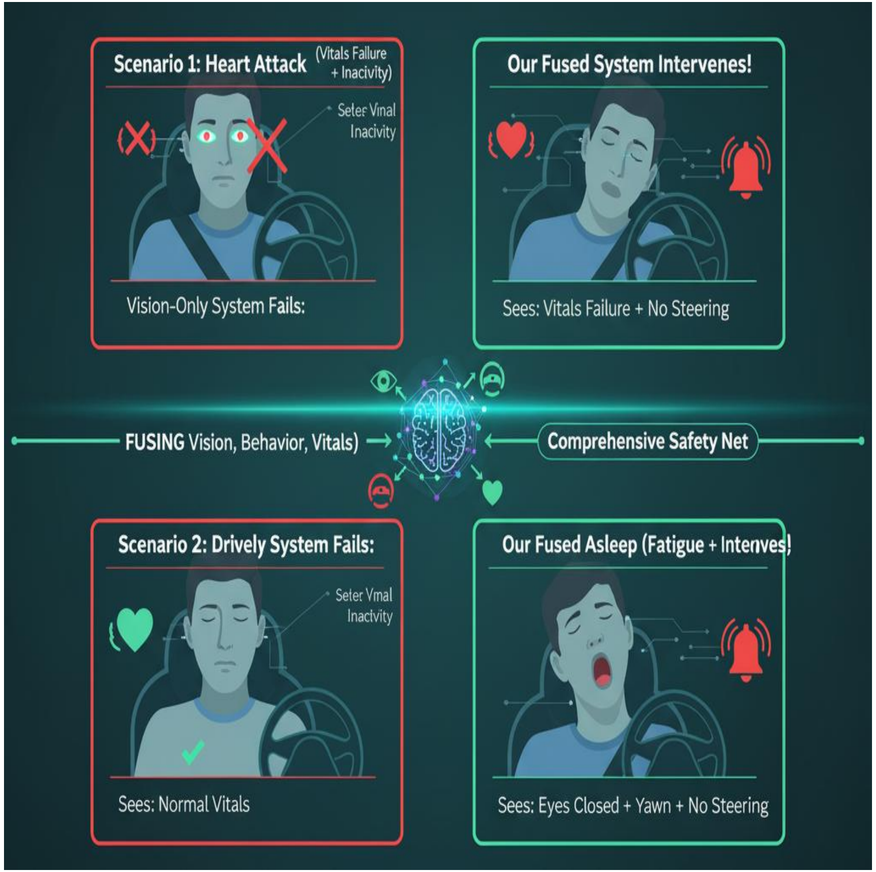
USP : The "Fused" Safety Net

So, why is our idea better? This is our single biggest advantage: The 'Fused' Safety Net. We are not just another drowsiness detector. By fusing Vision, Behavior, and Vitals, we can catch critical events that all other systems miss.

Let's look at two scenarios:

Scenario 1: A driver has a heart attack. Their eyes are open, looking forward. A 'vision-only' system sees 'eyes open' and does nothing. Our system, however, sees the 'vitals failure' and the 'lack of steering,' and it intervenes.

Scenario 2: A driver is healthy but falls asleep. A 'vitals-only' system just sees a 'normal resting heart rate' and does nothing. Our system sees the high eye-closure score, the yawning, and the lack of steering, and it intervenes.

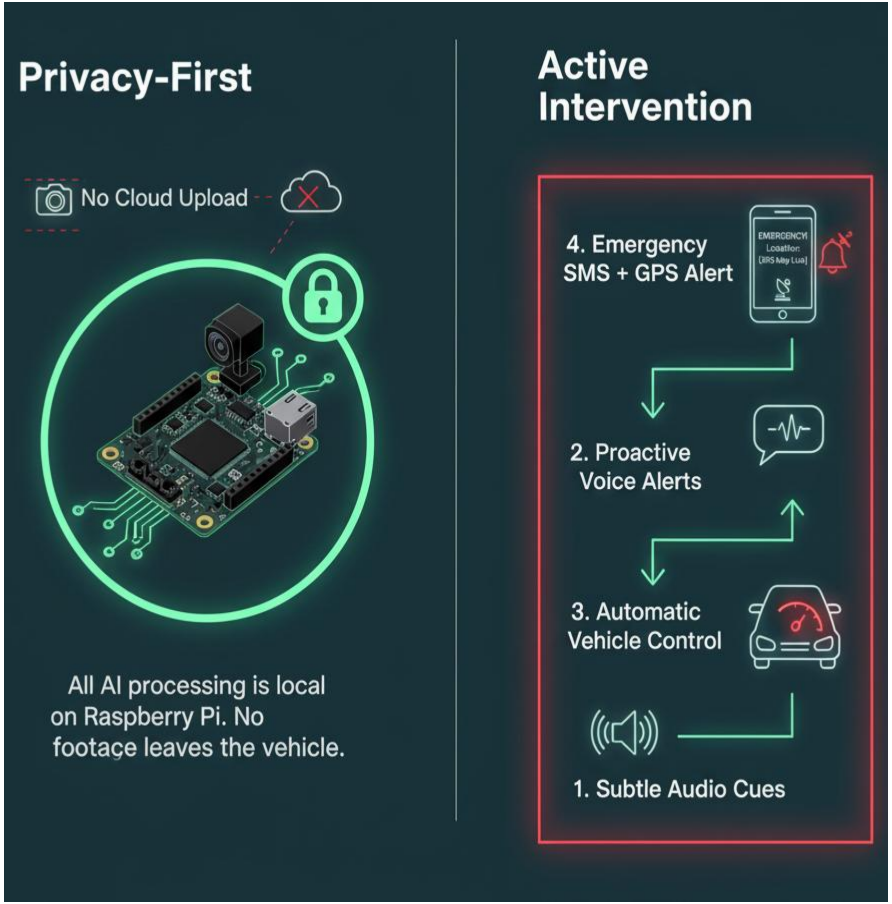


USP: Privacy & Active Intervention

Our advantage doesn't stop there.

First, we are Privacy-First. All AI processing happens locally on this Raspberry Pi. No sensitive camera footage ever leaves the vehicle. This is a critical concern for drivers, and we've solved it using lightweight models like Media Pipe.

Second, we are an Active Intervention System. Most systems just 'beep.' Ours escalates. It goes from subtle audio cues... to proactive voice alerts... and finally, to automatic vehicle control and sending an emergency SMS with GPS coordinates. It's a system that takes action.



Core Features (1: Vision)

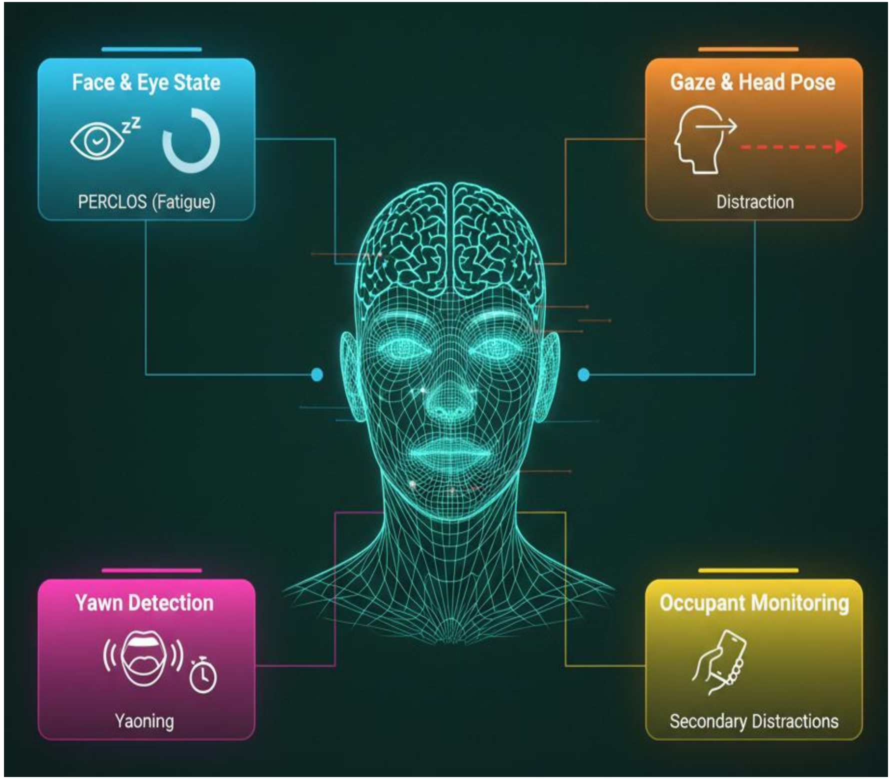
Let's look at the core features. Our vision pipeline is comprehensive. It detects:

Face & Eye State: We compute PERCLOS, the scientific standard for measuring fatigue.

Gaze & Head Pose: This detects prolonged distraction, like when a driver is looking at their passenger or out the side window for too long.

Yawn Detection: We use a sequence-aware model to accurately tell the difference between a real yawn and just talking.

Occupant Monitoring: And finally, we detect secondary distractions, like holding a mobile phone to the ear.

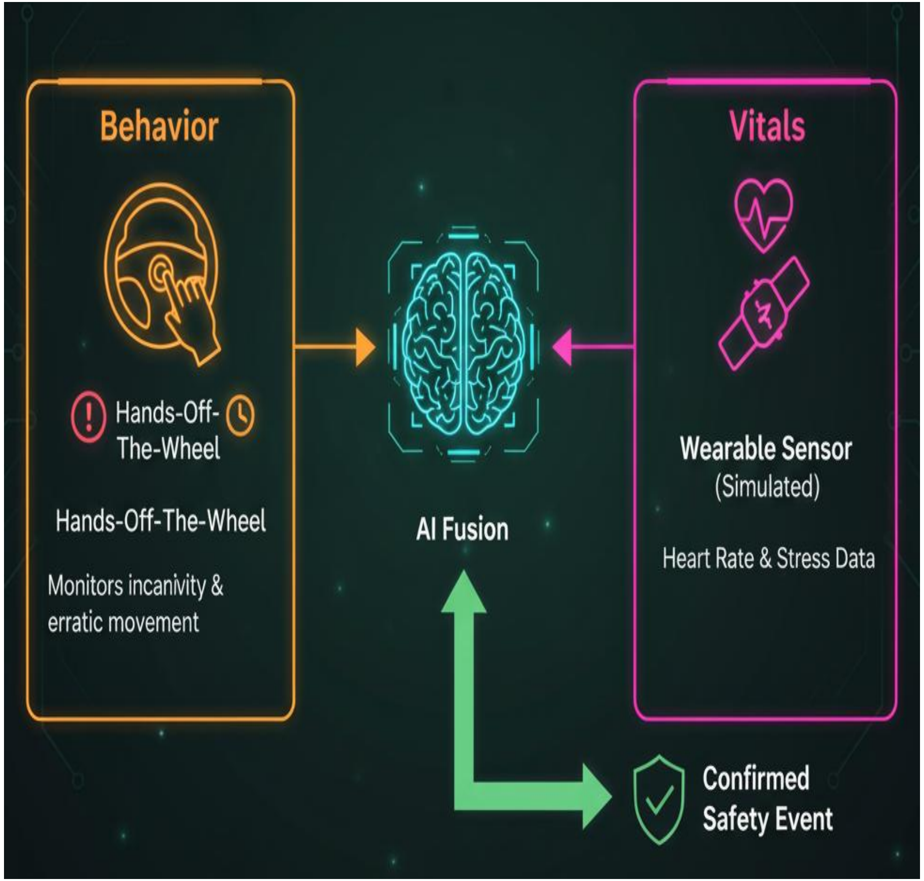


Core Features (2: Behavior & Vitals)

But vision is only one part of the puzzle.

For **Behavior**, we use our steering sensor to spot driving anomalies. It can spot erratic, jerky movements, but more importantly, it spots a complete lack of input a 'hands-off-the-wheel' state that confirms an emergency.

For **Vitals**, we prototyped a simulator that streams heart rate and stress data. This is the final check that can spot a medical event before it even becomes visible.



Core Features: (3: Intervention)

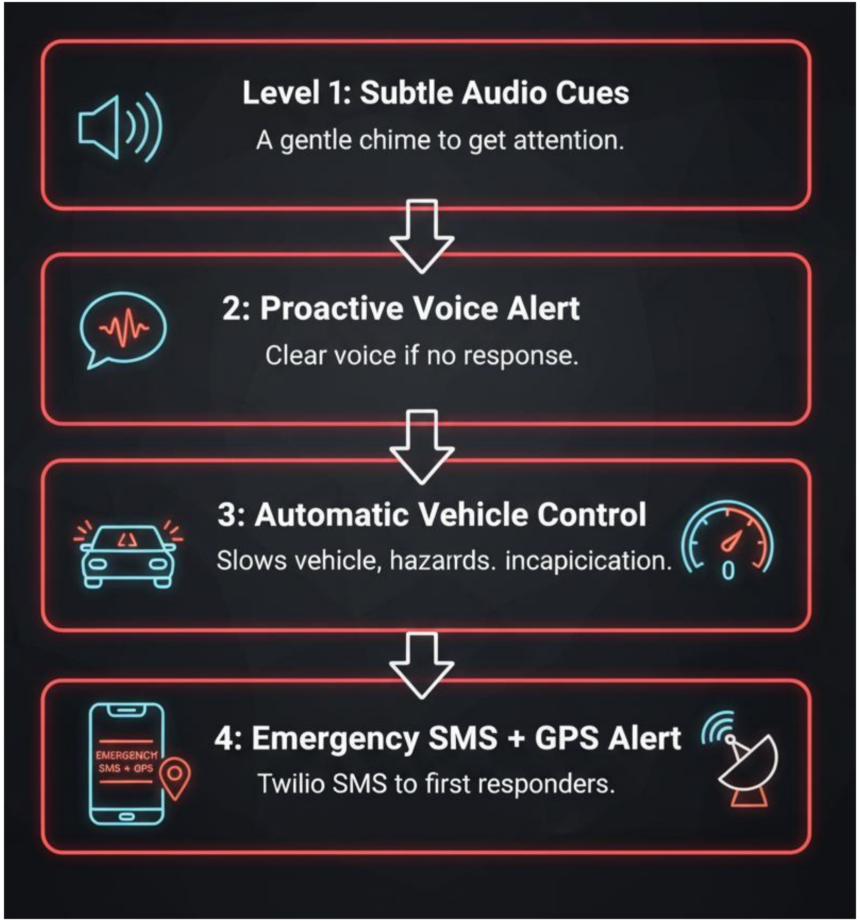
When our system confirms a high-risk state, our Tiered Intervention System activates. It's an intelligent, 4-level escalation:

Level 1: A subtle chime, just to get the driver's attention.

Level 2: If there's no response, a clear voice alert: 'Please take a break.'

Level 3: If the driver is still unresponsive, we assume they are incapacitated and begin automatic vehicle control—simulating slowing the vehicle and activating the hazard lights.

Level 4: Finally, we send an emergency SMS via Twilio, complete with the vehicle's last known GPS coordinates, to first responders."



System Architecture: The Logic Flow

So, how does this all fit together? The architecture is a robust, closed-loop system.

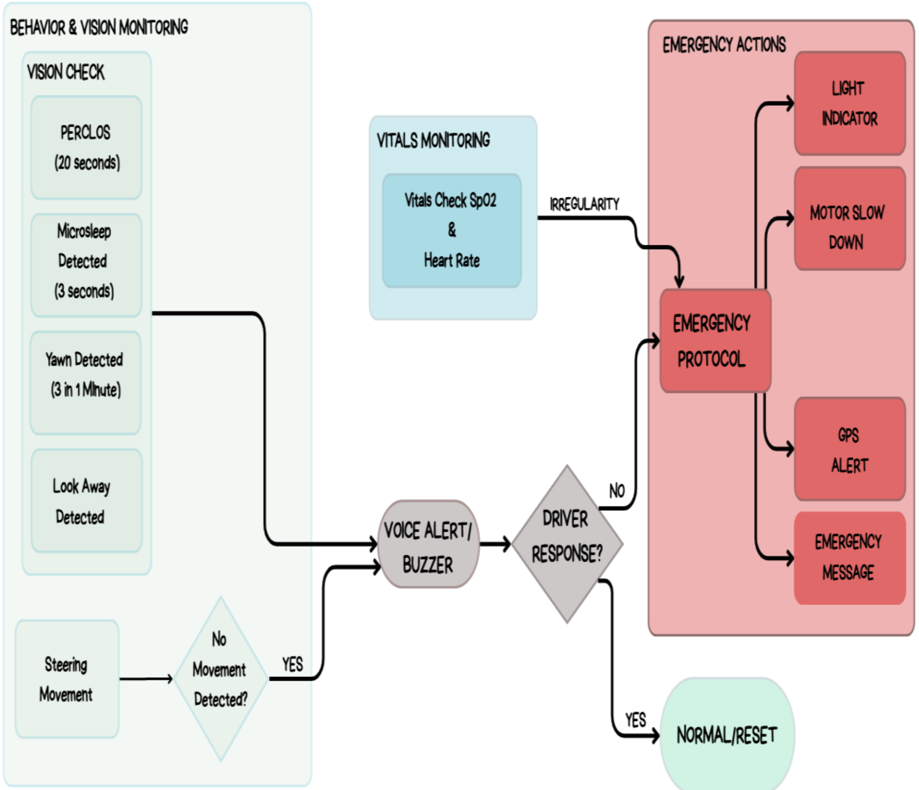
It starts with Constant Monitoring of Vision, Behavior, and Vitals in parallel.

If any of these checks fail like a high PERCLOS score, or irregular vitals, or no steering movement. the system triggers an initial Voice Alert.

It then asks a critical question: 'Is there a Driver Response?'

If YES, if the driver steers the wheel or their eyes open—the system resets to 'Normal.'

But if NO... the system assumes the driver is incapacitated.



Emergency Protocol: The Final Step

...and if there is no response, the Emergency Protocol is immediately activated.

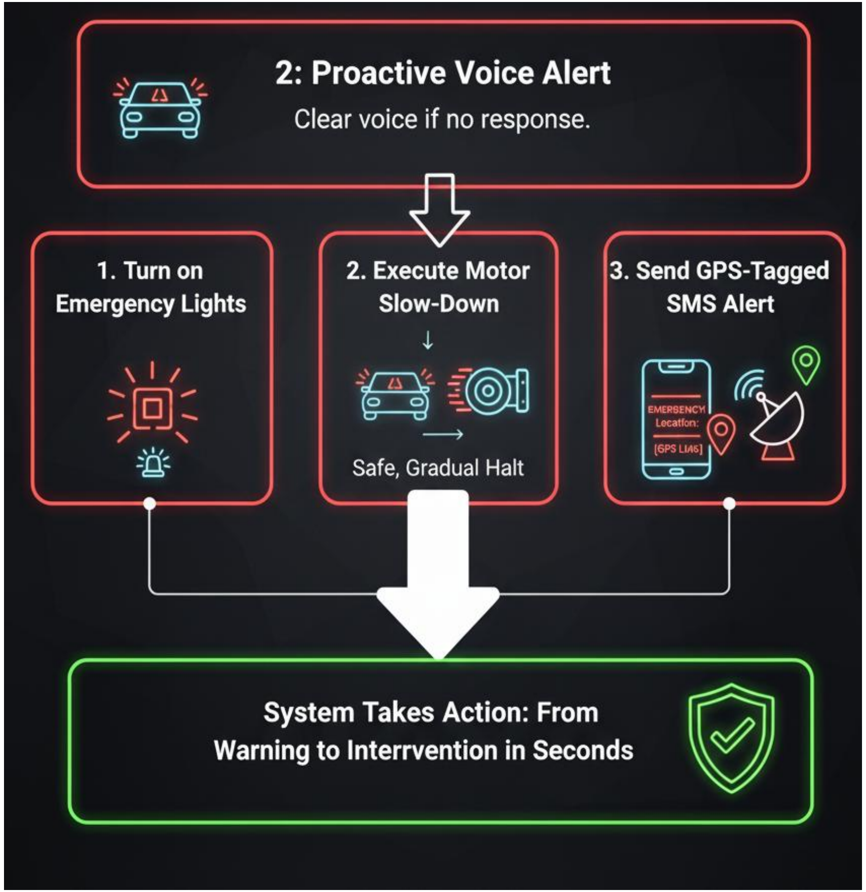
This is a hardware-level command to:

Turn on the emergency light indicator.

Execute the motor slow-down.

And send the GPS-tagged emergency message via Twilio.

This architecture allows the system to intelligently move from a simple warning to a full, life-saving intervention, all in a matter of seconds.



Live Prototype Demo

This all leads to our live prototype. Here you can see our hardware setup: the Raspberry Pi 4, the camera, and our steering sensor prototype.

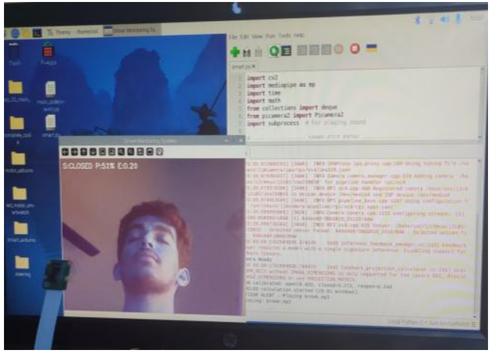
What I am about to show you is a live demonstration of this system in action. I will simulate..."

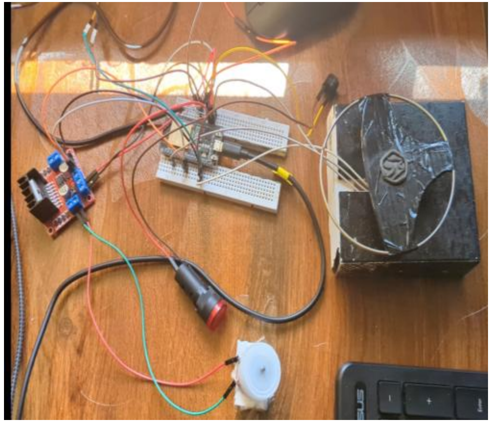
"First, I'll simulate fatigue by closing my eyes. Watch the PERCLOS score..."

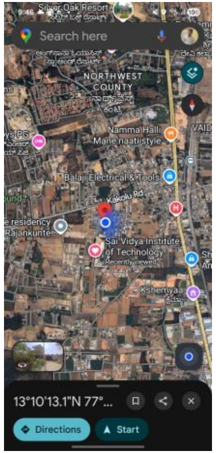
"Next, I'll simulate distraction by looking away..."

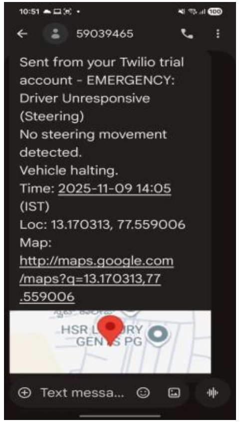
"Now, I'll simulate an incapacitated driver by taking my hands off the wheel..."

"And as you can see, the emergency alert has just been sent to my phone."









Technology Stack

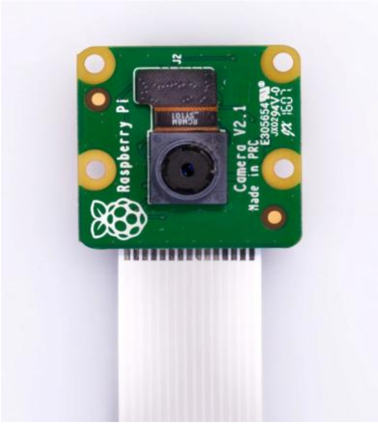
To build this prototype, we used a powerful and efficient stack of technologies.

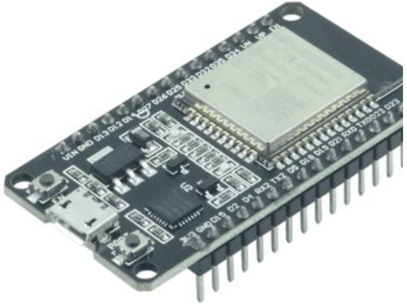
On the hardware side: A Raspberry Pi 4 and a Pi Camera.

For the AI and Vision: We used Python, OpenCV, MediaPipe for its lightweight facial landmarks, and TensorFlow Lite for our custom models.

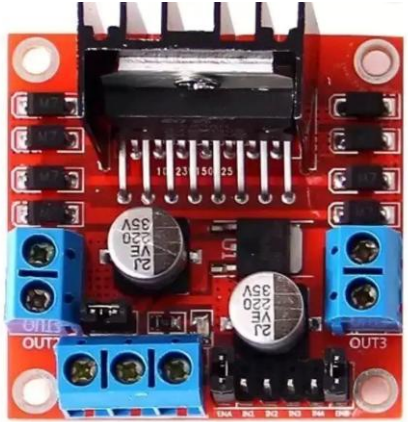
And for the backend and alerts: We used the Twilio API for SMS and the Google Maps API to provide a location link.

Components We have used:







Conclusion & Future Work

In conclusion, our project demonstrates a significant leap forward in driver safety.

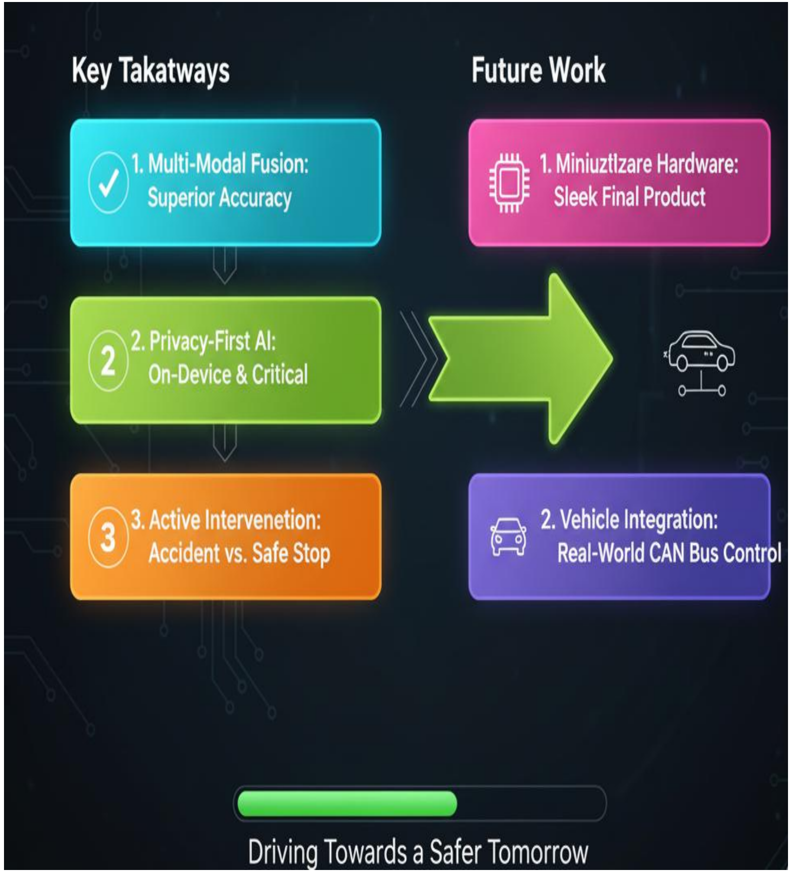
We've proven that:

Multi-modal fusion is far more accurate than any single-focus system.

Privacy-first, on-device AI is not only possible but critical for user adoption.

And that an active intervention system can be the difference between an accident and a safe-stop.

Our future work would focus on miniaturizing the hardware for a sleek, final product and integrating directly with a vehicle's CAN bus for real-world control.



THANK YOU