COMMA - Communicating Driving Confidence and Limits

Case Study & Presentation

,

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Introduction

The Problem

Openpilot, a level 2 advanced driver assistance system by comma, struggles to effectively communicate its driving confidence and operational limits (torque on steering wheel, brake pressure, and acceleration it can apply) to users. Current methods, such as audible alerts for steering torque limits, are intrusive and provide insufficient preemptive information.

Objective

The objective is to design an intuitive, non-intrusive UX that conveys real-time driving confidence and operational limits, ensuring that the driver is always aware of how much they can rely on openpilot and how close they are to reaching the vehicle's physical limits. This helps the driver to remain engaged and ready to take over when necessary, ensuring safety and confidence in using the system.

Design Approach

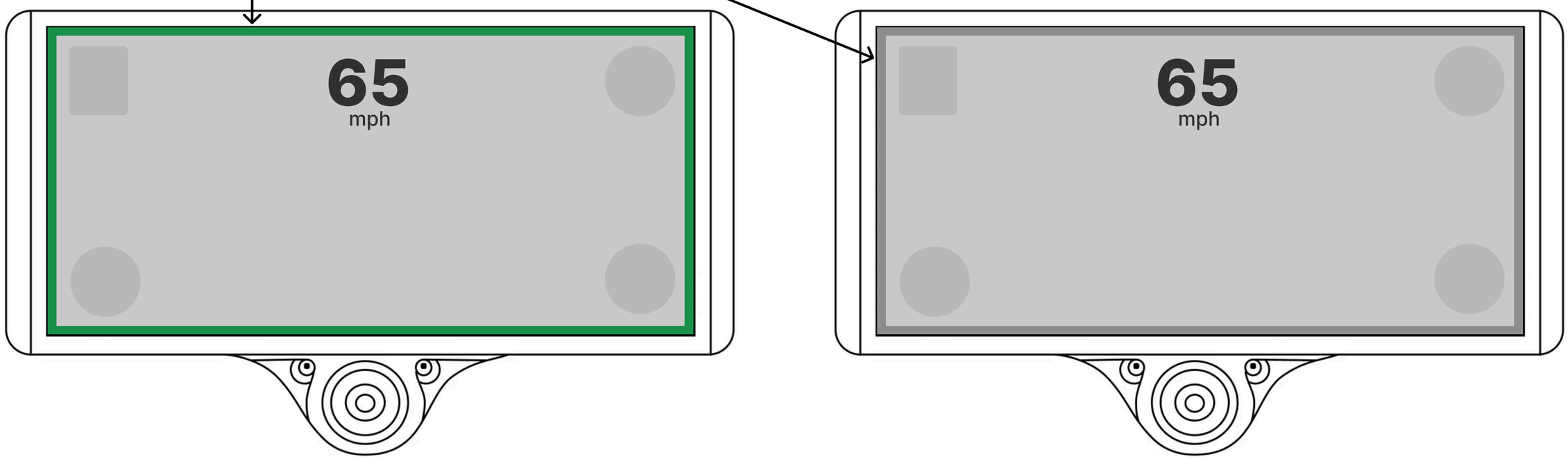
The design solution was split into two parts: Part 1, solving "Driving Confidence," and Part 2, solving Operational Limits. The goal was to work with the current interface and limit any new hardware design.

Part 1 - Driving Confidence

Let's first start by solving the openpilot driving confidence problem. For this, let's first take a look at the existing UI.

Openpilot Engagement Indicator

In the current UI of the system, there is a green border that is used to indicate whether openpilot is engaged or not (green for engaged, grey for engaged with human override, dark blue for disengaged).



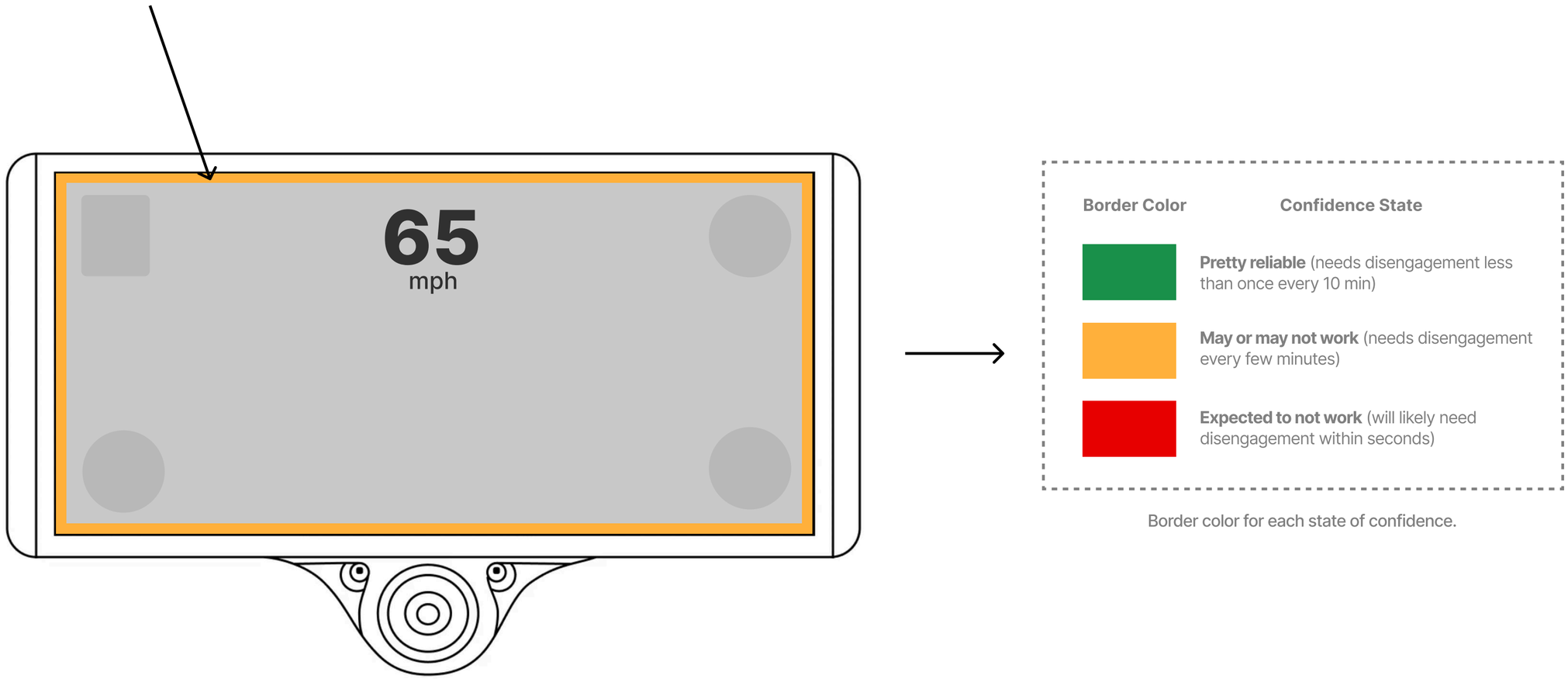
Openpilot engaged (Green Border)

Openpilot engaged with human override.

Current UI - Wireframe

Openpilot Engagement Indicator (Update)

This can be changed to indicate the confidence level of openpilot by simply changing the color for each level of confidence/state. For example, green for ‘pretty reliable’, orange for ‘may or may not work’, red for ‘expected to not work’.



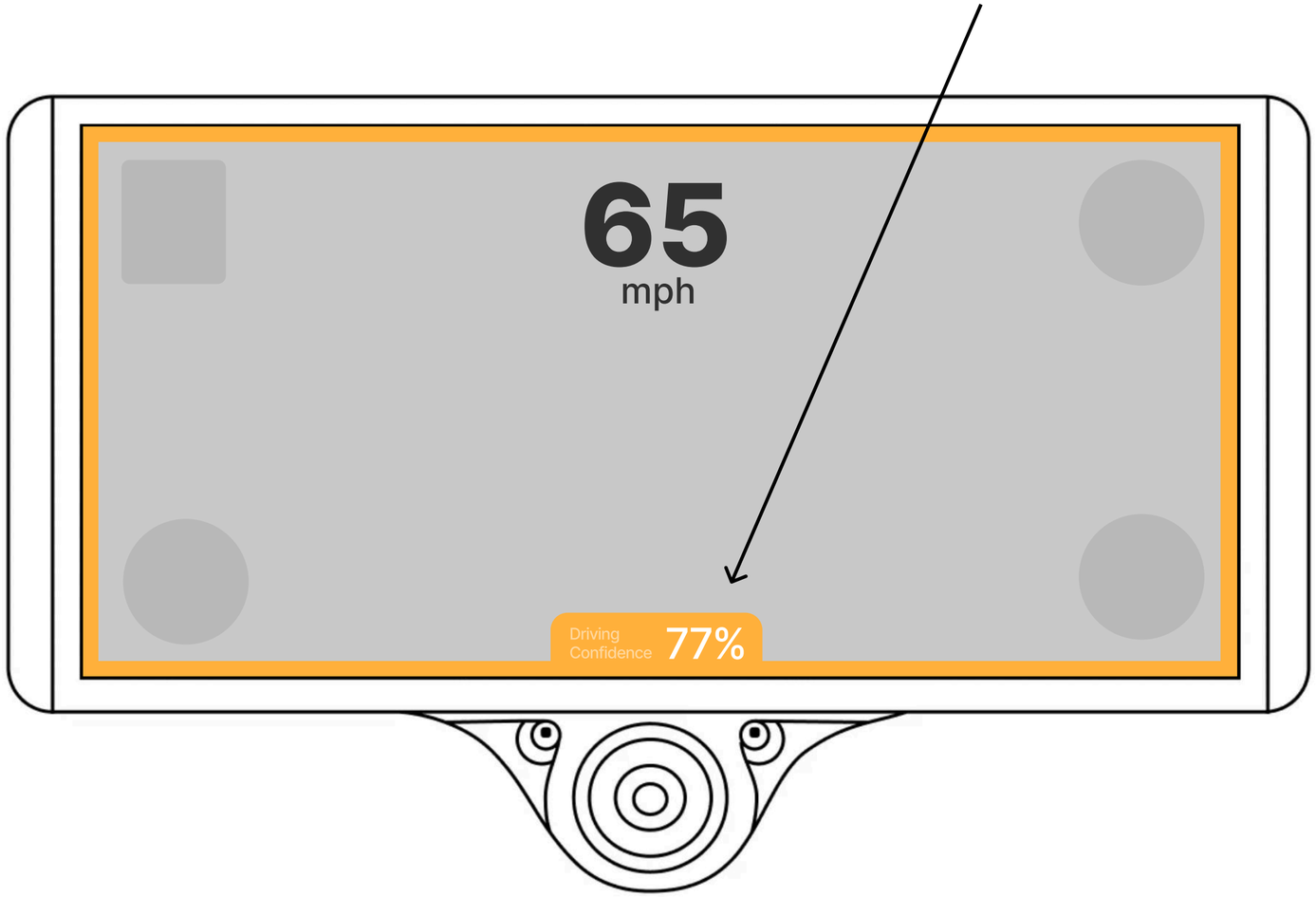
Openpilot Engaged with Driving Confidence “May or may not work” (Orange Border)

Border color for each state of confidence.

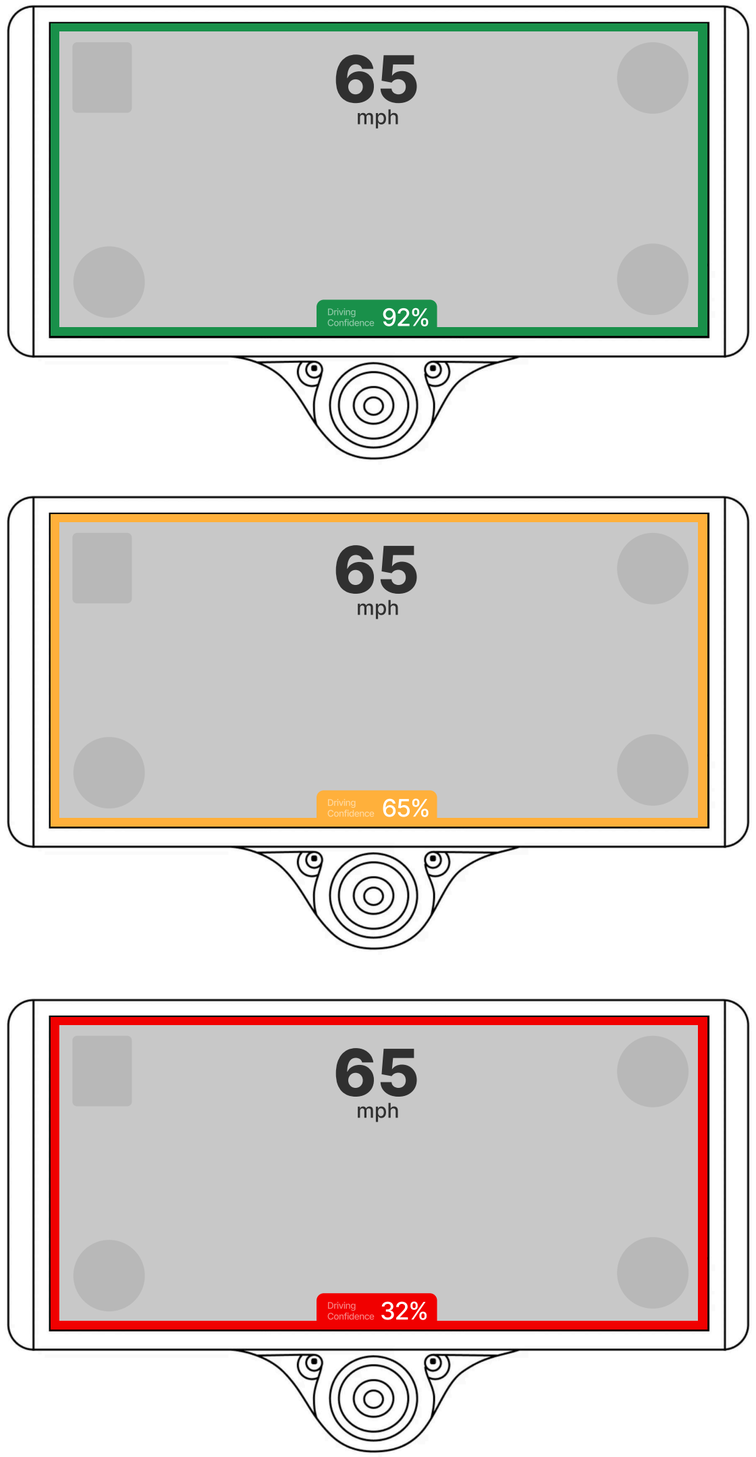
Design Solution

Driving Confidence Percentage

Since the driving confidence is on an analog value, we can add a percentage as well to give an additional indicator to the user. This can be placed in the bottom center connected to the border.



Design Solution



70% >

Pretty reliable (needs disengagement less than once every 10 min)

70% - 40%

May or may not work (needs disengagement every few minutes)

40% <

Expected to not work (will likely need disengagement within seconds)

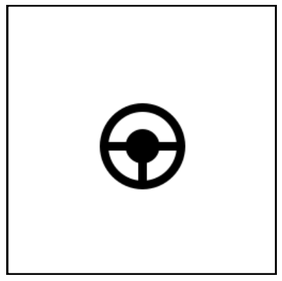
Part 2 - Operational Limits

Now let’s look into how we can indicate to the user operational limits of openpilot.

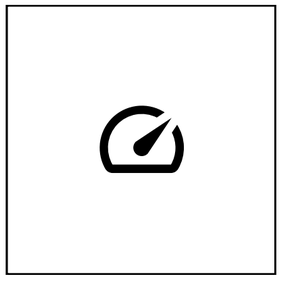
Ideation

Ideation

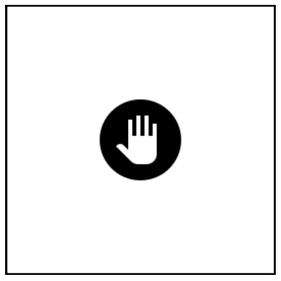
We can take several approaches to showcase the operational limits. The ideal solution should be minimal and not intrusive.



Steering



Acceleration

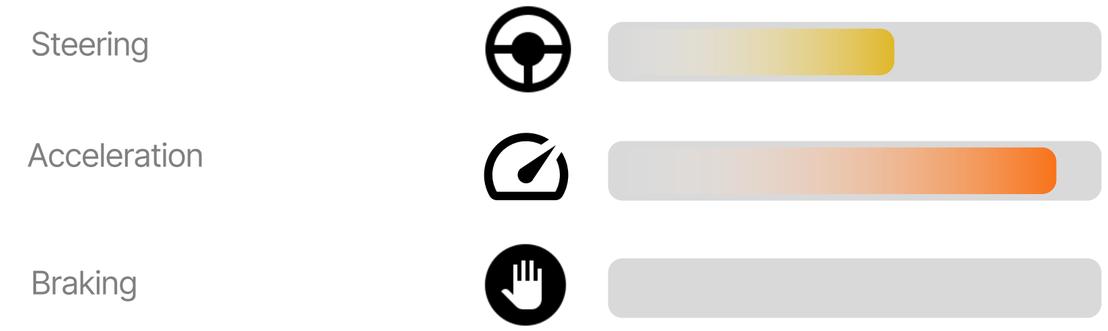


Braking

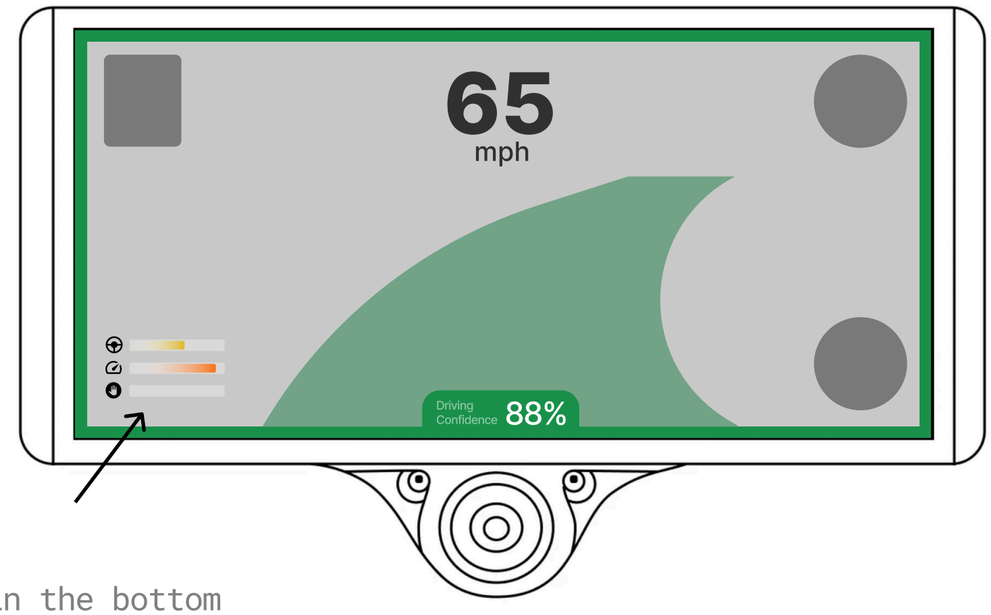
Design Concept #1

Design Solution #1 - Simple Gauges

The simplest solution would be to use gauges to indicate OpenPilot’s operational limits for Steering Torque, Acceleration, and Braking. These gauges will visually display how close the system is to its limits in each category.



Design Concept #1



Gauges

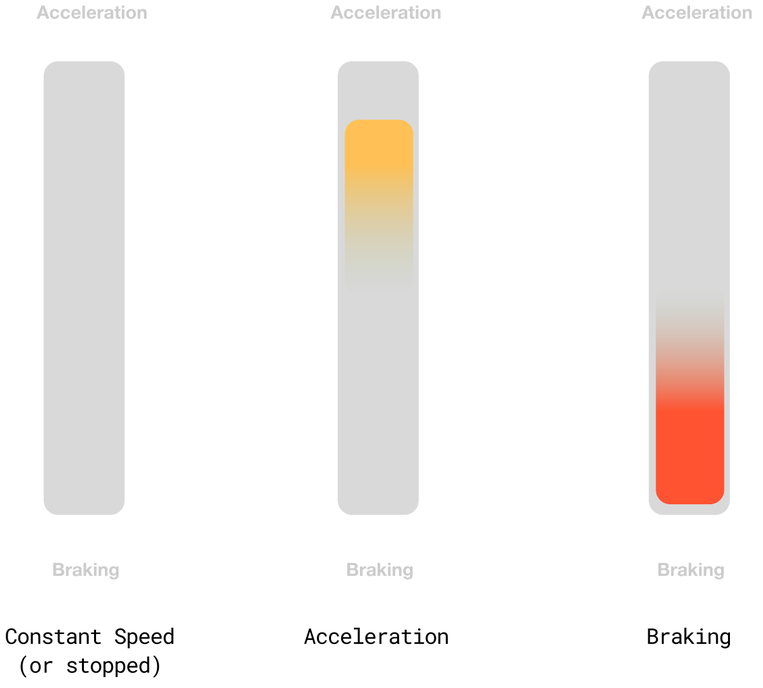
These gauges can be placed in the bottom left corner.

Can we make it more intuitive?

To enhance user understanding, the orientation of each gauge will align with what it represents:

Acceleration and Braking: Represented by a single vertical gauge that fills upwards for acceleration and downwards for braking, with a neutral position at the center.

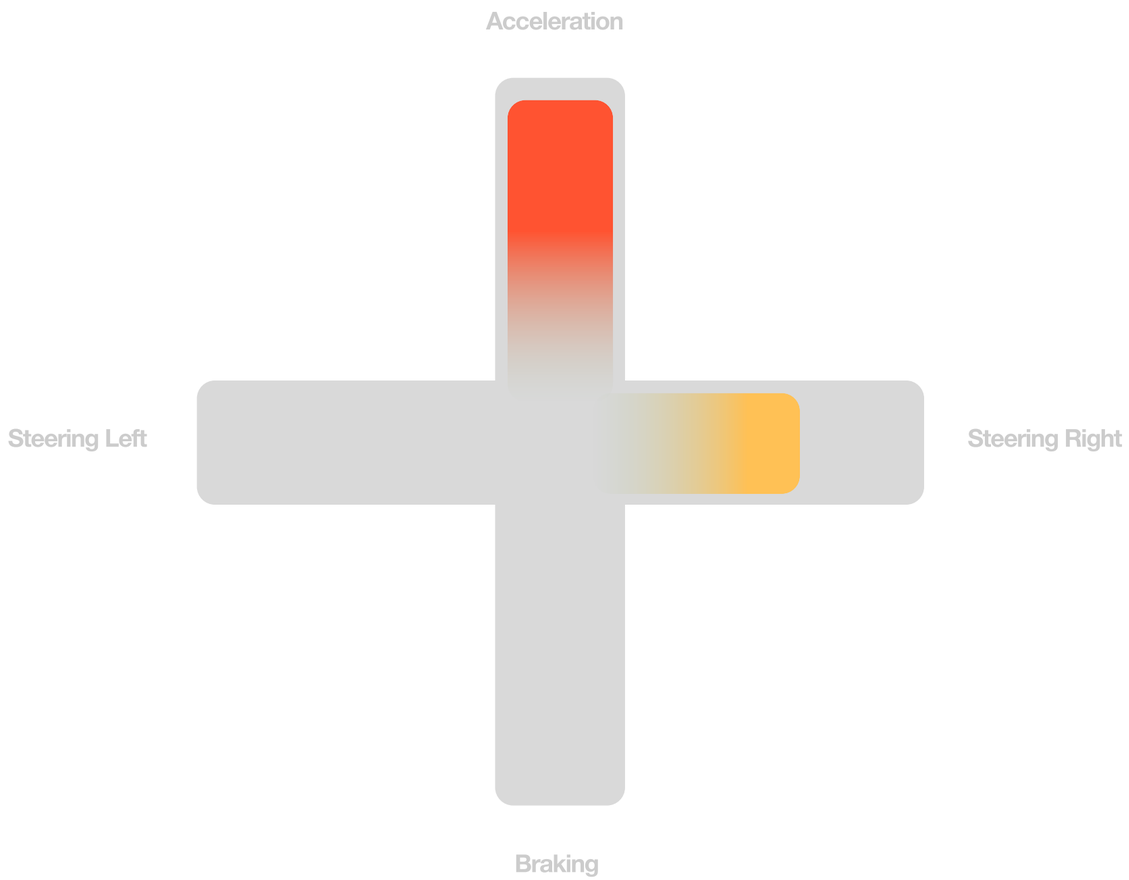
Steering Torque: Represented by a horizontal gauge centered at neutral, filling left or right depending on the direction of the turn.



Design Concept #2

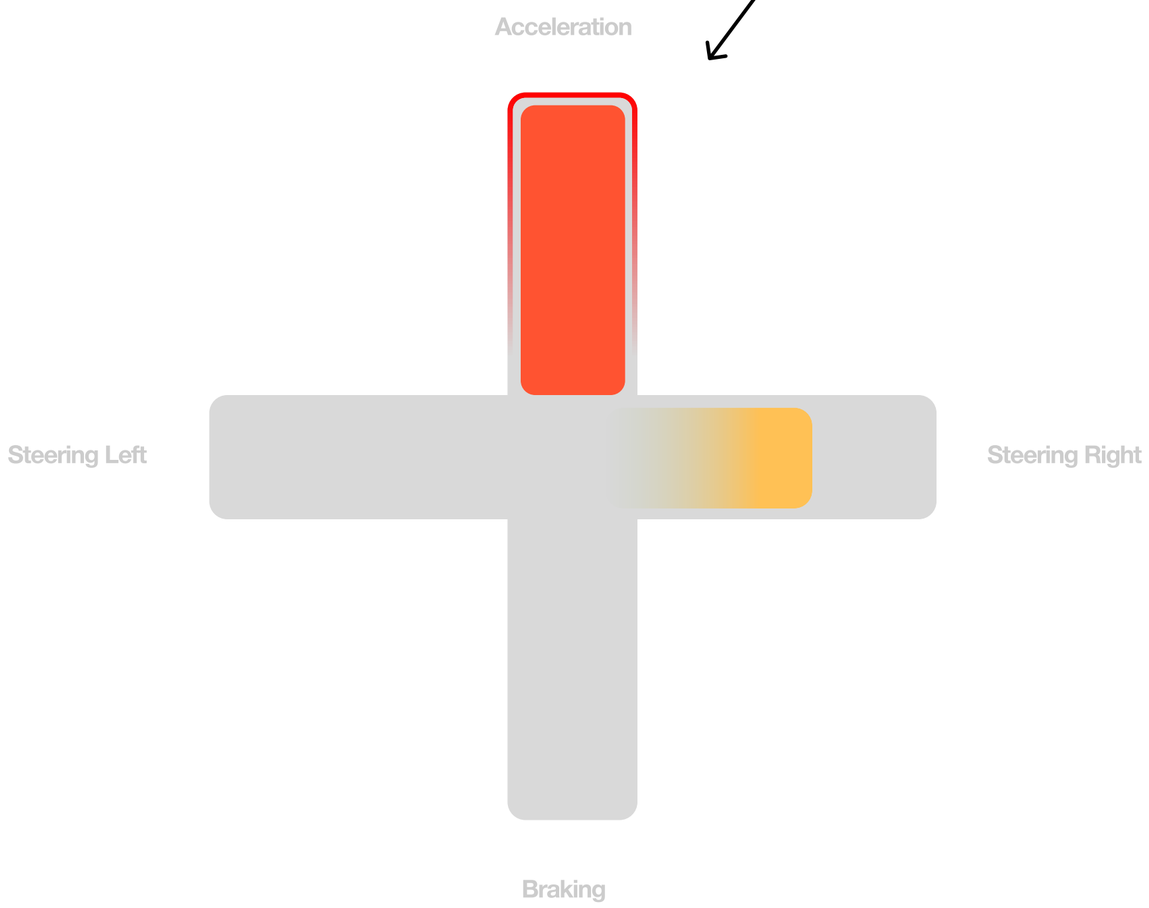
Design Solutiion #2 - ‘Cross’ Gauge

To streamline the interface, we can combine these into an elegant ‘cross’ gauge. This combined design enables the driver to see acceleration/braking and steering information at a glance, improving the overall intuitiveness of the design.



Limits reached

When the system limit is reached, we can have the gauge pulse red. In this case, the acceleration limit was reached.

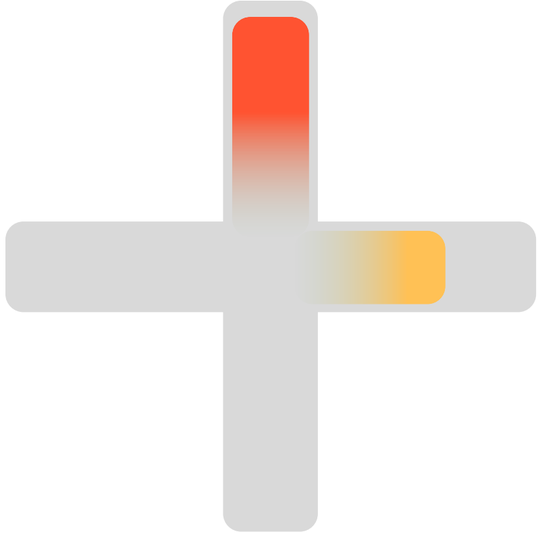


Design Concept #2

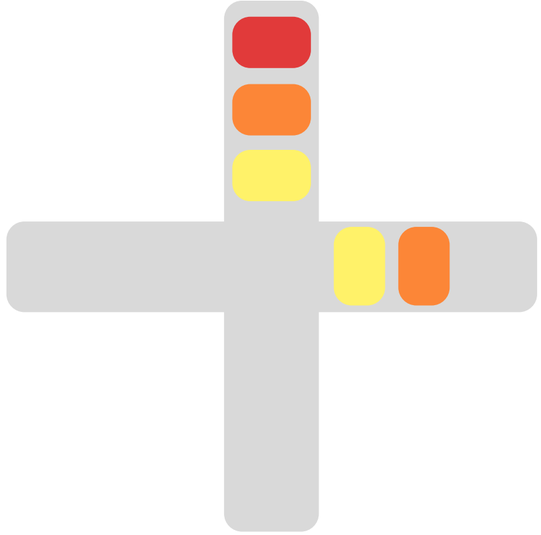
Alternative Versions

Three different versions of the gauges were designed to explore how best to communicate the system’s operational limits. Each version emphasizes simplicity and intuitiveness while addressing concerns about visual clutter. However, their true effectiveness can only be determined through user testing.

Testing will help evaluate which version performs best in terms of clarity, driver engagement, and minimal distraction, ensuring the final design is both functional and user-friendly.



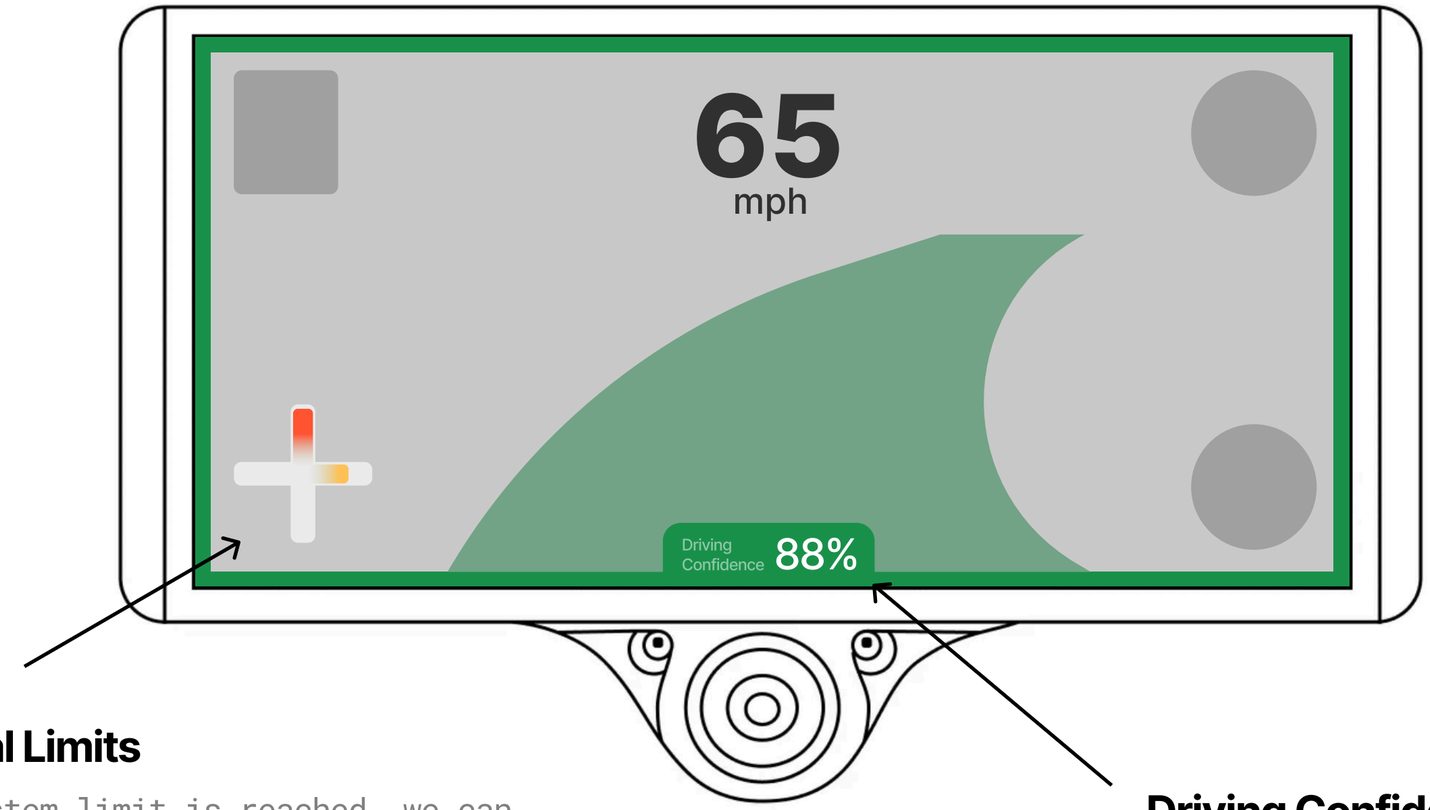
Current Version



Alternative Version

Alternative Version #2

Final Concept



Operational Limits

When the system limit is reached, we can have the gauge pulse red. In this case, the acceleration limit was reached.

Driving Confidence

When the system limit is reached, we can have the gauge pulse red. In this case, the acceleration limit was reached.

Assumptions and Considerations

Due to the constraints of this design challenge, formal user research and in-depth user testing were not feasible at this stage. However, extensive footage of users interacting with OpenPilot was reviewed to gain insights into user behavior and preferences. Based on these observations, many design decisions were made based on assumptions and industry best practices. Below are some key considerations:

1. **Assumption of User Need:** It was assumed that communicating driving confidence or operational limits (or both) is a critical problem for users. However, it's possible that users may not find these indicators necessary in practice. Further user research is required to validate whether addressing this issue is genuinely valuable to the OpenPilot experience.

2. **Visual Clarity:** It was assumed that minimizing visual clutter is a priority to avoid overwhelming the driver with too much information, based on best practices for in-vehicle interfaces.

3. **User Focus:** The design assumes that drivers need clear, non-distracting feedback to maintain focus on the road while still being aware of operational limits.

4. **UI-based Feedback:** The solution is designed to rely entirely on visual (and potentially auditory cues) for communicating operational limits, assuming that these forms of feedback are sufficient to alert the driver without causing distraction.

5. **User Testing:** While no formal user testing was conducted in the initial phase, footage of real users interacting with the system provided valuable insights into potential pain points and user behavior. These observations informed many of the design decisions, but further testing will be necessary to refine the solution.

These assumptions, while not confirmed through direct user testing, helped shape the design direction and are open to revision after further testing.

Potential Improvements

Every design solution has room for refinement. With additional time, these are the key areas that could be further developed:

1. **Incorporate Formal User Testing:** Conduct structured user testing sessions with real drivers to validate the design's clarity and effectiveness. Observing how users interact with the solution will provide actionable insights for refinement.

2. **Explore Steering Limit Indicators:** Investigate alternative methods for representing steering limits, such as subtle UI overlays or animations, to effectively communicate these constraints without overwhelming the driver.

3. **Enhance Contextual Visibility:** Fine-tune the thresholds for when indicators appear and disappear to ensure they are shown only when necessary, reducing potential distractions while maintaining their utility.

4. **User-Customizable Feedback:** Explore options for allowing users to personalize their interface, such as adjusting the sensitivity of visual alerts or toggling between different visual styles.

5. **Gather Feedback from OpenPilot Users:** Collaborate with the OpenPilot community to identify additional pain points and gather suggestions for improving the design based on real-world experiences.

6. **Iterate with Real-World Data:** Use telemetry data from OpenPilot to identify common scenarios where operational limits are reached, tailoring the design to address those situations more effectively.

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7. **Explore Multi-Sensory Feedback:** While the current design is visual, consider future iterations that integrate subtle auditory or haptic feedback to provide a more holistic and less intrusive alert system.

These improvements aim to enhance the design's effectiveness, user satisfaction, and ensuring it meets the needs of OpenPilot users.

Thank you for your time.