User Experience Portfolio

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(open me in Adobe Acrobat for my interactive elements to work.)

Aging Driver Interface

This ongoing project was started as an attempt to design for the needs of a user who's particular disabilities are traditionally ignored by the automotive industry; the aging driver.

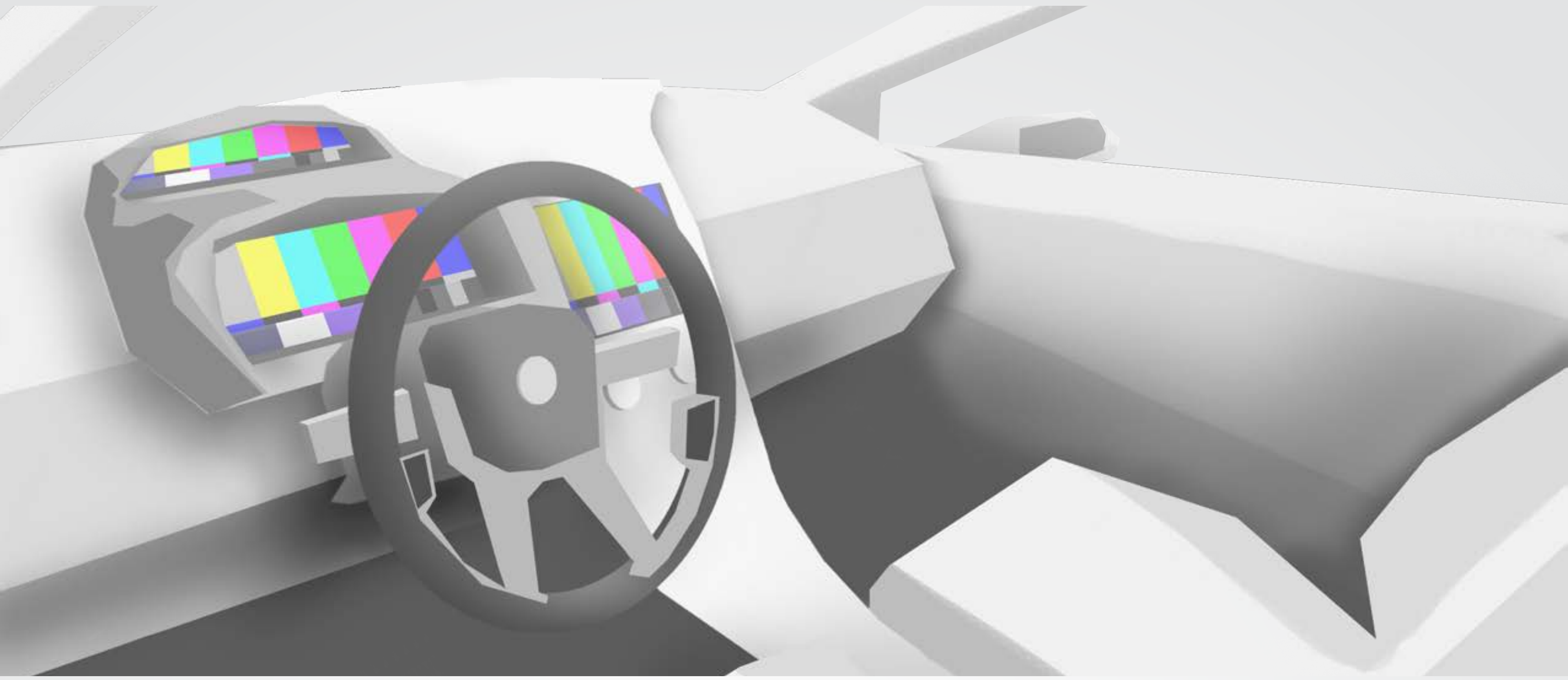
As this population of people continues to grow and age, their bodies are undergoing a number of changes that make them less able drivers. The changes taking place of specific importance to this project are the degradation of the visual system and the occurrence of Mild Cognitive Impairment (MCI). MCI is characterized by loss of a range of cognitive abilities, including declarative/spatial memory and higher-order/executive functions.

These changes can build up for an aging driver, creating a very hostile driving environment. Some drivers attempt to compensate using tactics such as: only navigating protected left turns, limiting/not driving at night, navigation only known routes, relying on a co-pilot, increasing safe-gap margins.

Even with these attempts at self compensation, aging drivers still make up a large portion of the fatal driving accidents in the US. In this project I worked to create a set of driving displays that would assist the aging driver. Allowing him to continue driving, do so safely and with as much freedom as possible.

I approached the task of creating a new set of driving displays by first separating the driving task into the primary task and the secondary task. The primary task being direct control of the vehicle and the secondary task being that of navigating to the destination.

I wanted to focus on creating an interface that facilitates the primary task of safely piloting the vehicle as it is easier to find effective compensatory measures for navigation. This made the navigation interaction a secondary, though still important goal.

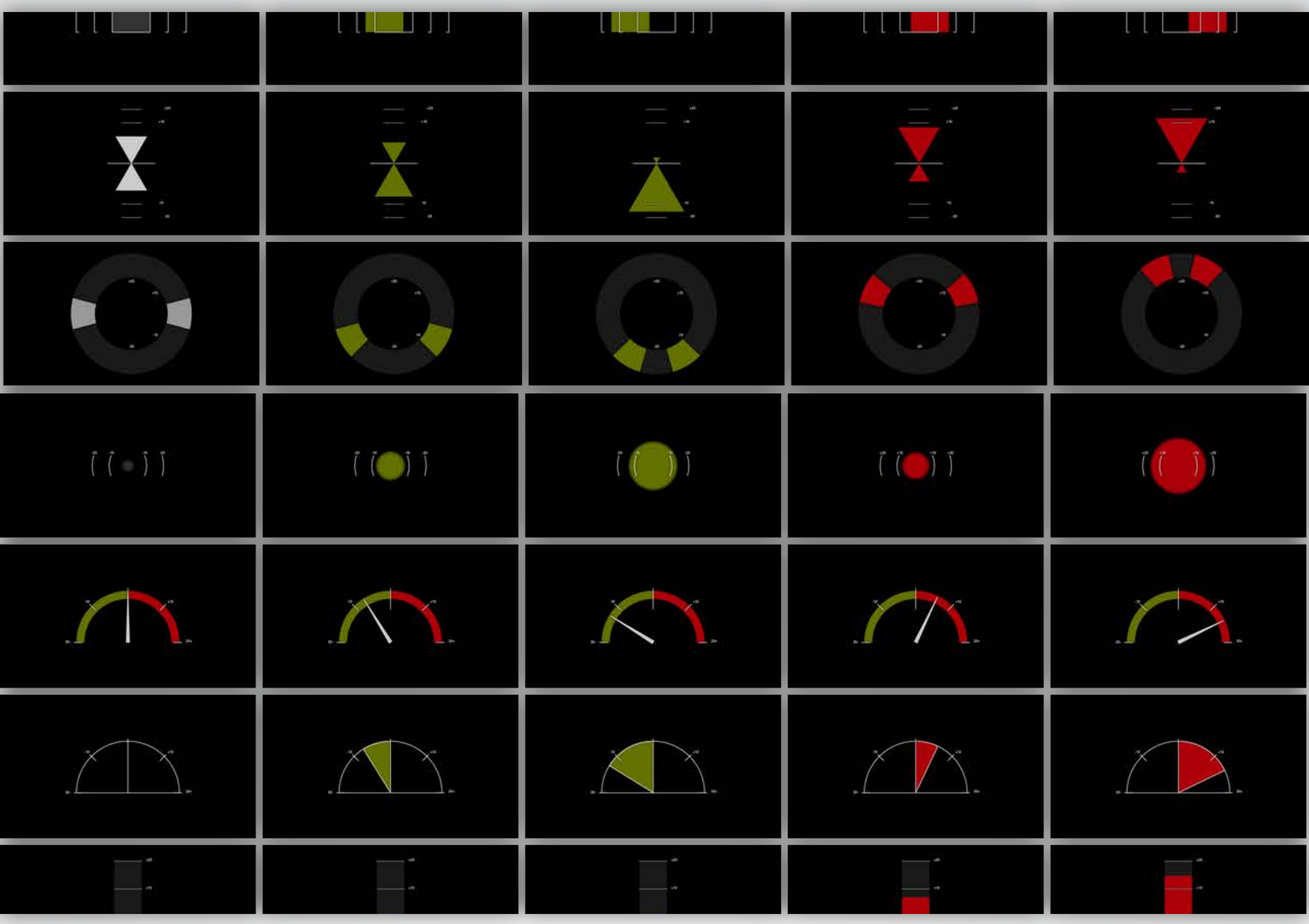


Work began by defining the physical layout of the display surfaces in the vehicle. The decision was made to move the primary display into a high heads down position to minimize the effort of switching between focusing on the outside world and the vehicle gauges. This is particularly important for the aging driver as the eye's ability to perform this refocusing act slows significantly as it ages, leading to more eyes-off road time and disorientation.

The space traditionally occupied by the primary instrument would be occupied by a secondary screen dedicated to navigation and other secondary tasks. This allows for much faster access of navigation information as compared to display on a vehicle center located display. The ease of eye rotation in the y-axis vs the tendency to move one's entire head to rotate view on the x-axis allows for a much lower workload, faster refocusing and particular advantage to anyone with joint pain.

I evaluated the necessary information for piloting the vehicle as well as what information is readily available that might be helpful in this context. The tachometer was removed as this is not intended for a manual transmission vehicle, engine temperature was removed as it falls into the category information that is only needed if there is something wrong. This leaves a speedometer, fuel, turn signals, our addition of a blind spot monitoring system and discrete warning icons as the necessary pieces of information.

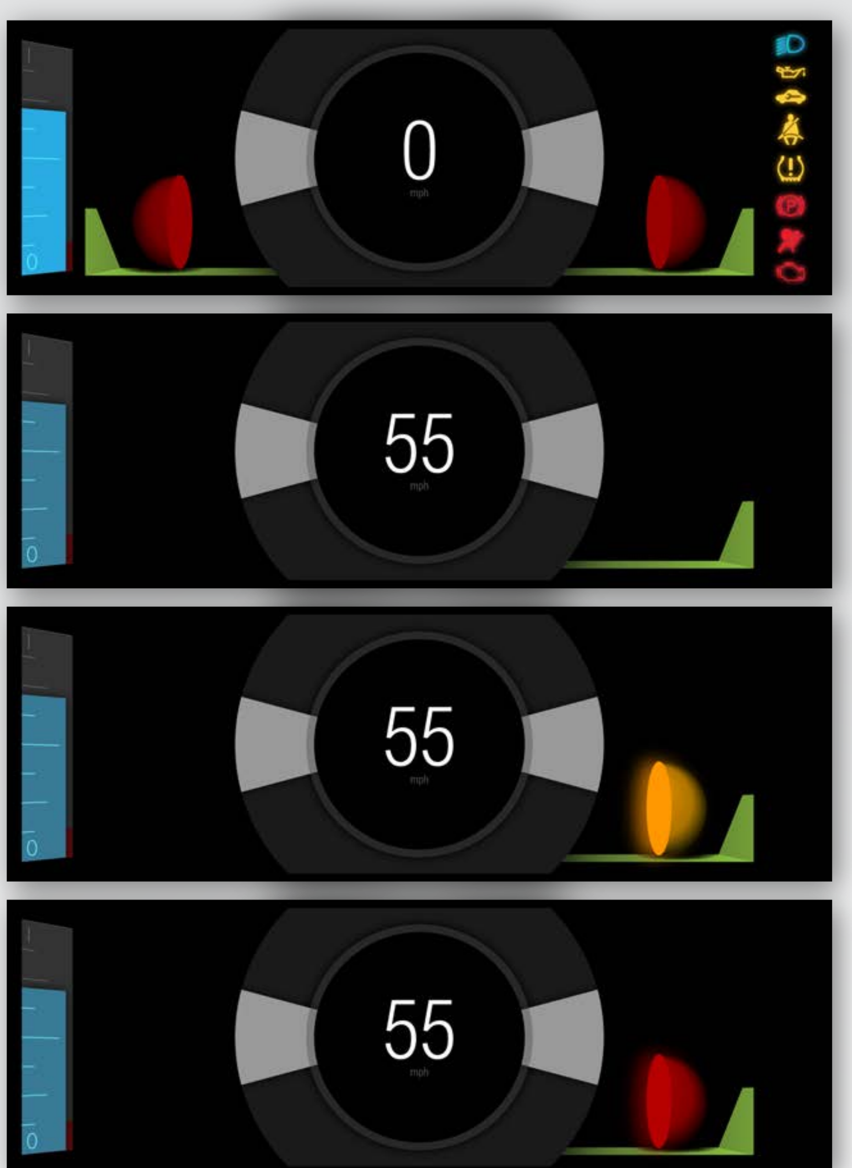
Starting with work on the speedometer, I found myself drawn to the idea of a relative speed gauge rather than the traditional, absolute gauge. The difference being an absolute gauge has static limits and scale whereas a relative gauge changes to suit the context at hand. I felt that there could be a reduction in the required effort of a speed check loop as well as relieve the necessity to constantly monitor the environment for speed limit signs.



After initial concept exploration, I chose a series of 9 of the most promising relative speedometer designs to test in a simple desktop experiment. This involved showing subjects instructional videos on how each simplified speedometer worked and then answer as quickly as possible questions about wether or not the gauge in different states was above or below the speed limit. The gauges were then compared for accuracy and speed of response.

This simple research exercise provided valuable insight into which gauges were most likely to be effective and which were best abandoned.

High Heads-Down Display



Arthritis of the neck

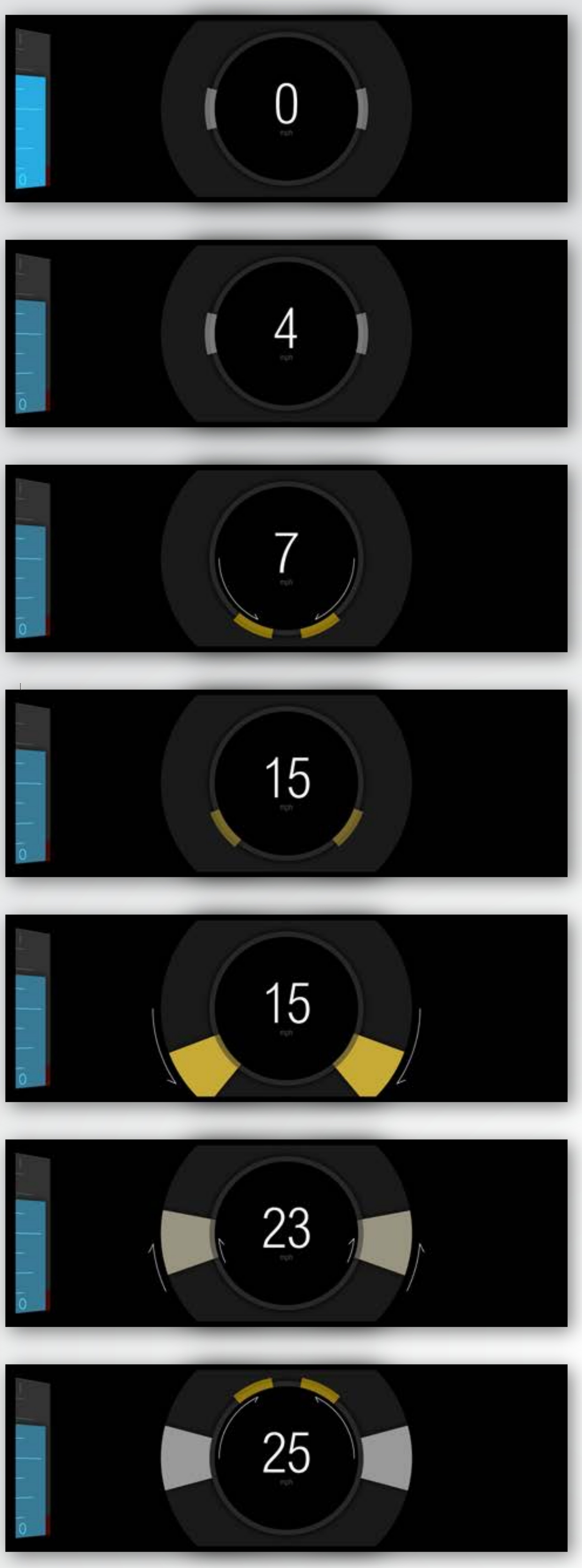
The blind spot warning system functions in conjunction with the turn signals. Here the right turn signal has been turned on and the system is indicating that the driver's right blind spot is clear of another vehicle.

If a vehicle enters the driver's blind spot while the turn signal is on, an amber hemisphere appears and visually indicates to the driver that there is something blocking the lane change.

If the driver ignores or does not see the warning and begins changing lanes into the space of the second vehicle, the hemisphere turns bright red and is joined by an audible warning in an attempt to avoid a collision.

The primary display with turn signals, a blindspot warning system, fuel gauge and both relative and digital absolute speedometers. The inclusion of the blind spot warning system is of particular importance due to the prevalence of cognitive and visual tunneling in aging drivers. The placement of large warning iconography finished the design.

Relative Speedometer



Telling the future

The design centers around the relative speedometer. In areas that the vehicle does not know the speed limit, the gauge remains in its neutral state. (fig. 1)

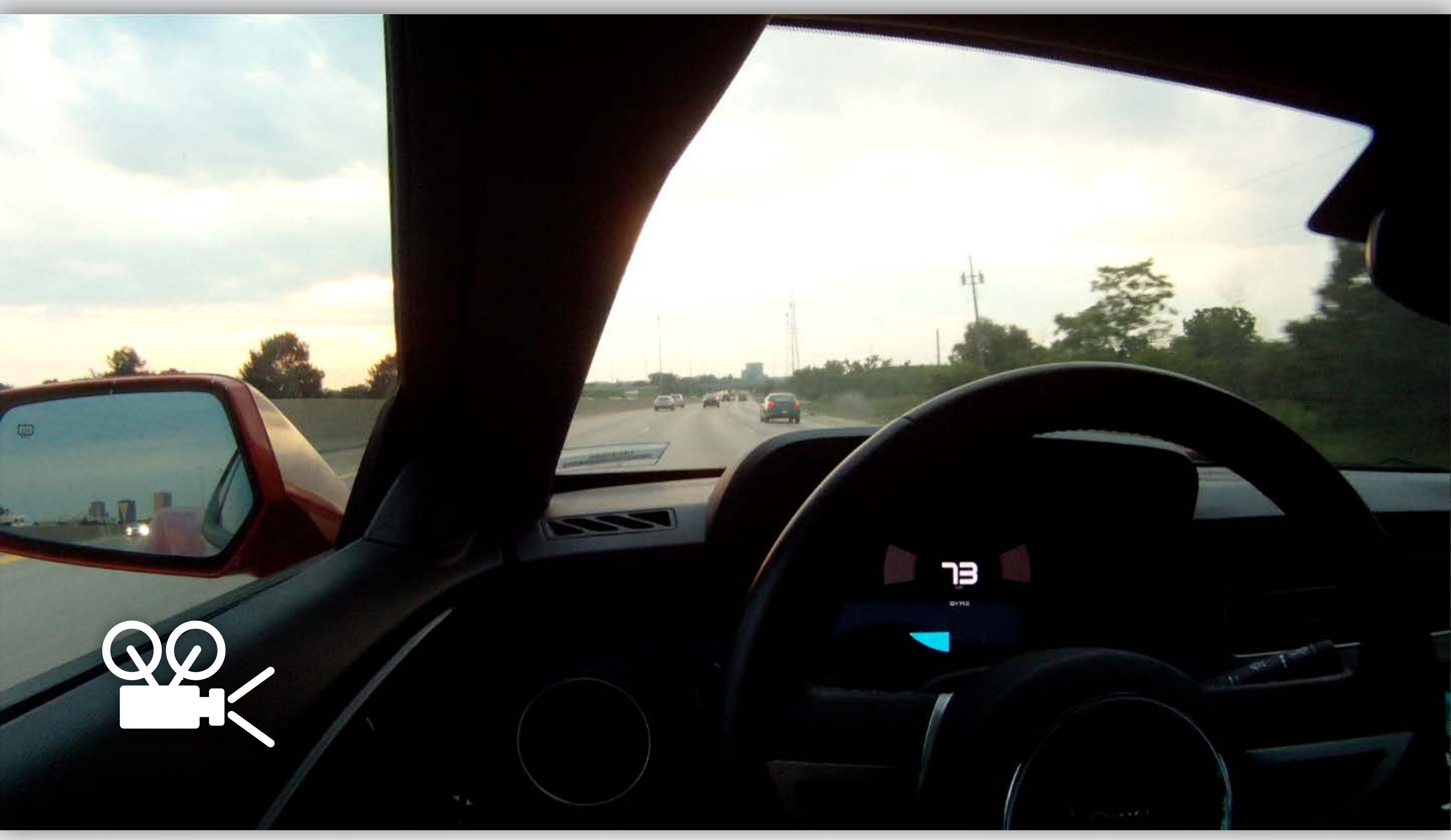
As the vehicle approaches a road with a known or different speed limit, it begins to change. If the vehicle will be below the speed limit when it reaches the new area, the indicators rotate down to indicate being below the limit. They also change color the farther they deviate from horizontal; changing in both saturation and luminosity, turning a bright amber at either vertical position. The color change allows the indicators to move up in the visual hierarchy of the display as they have more important information to communicate to the driver.

The inner indicator continues to move and change color to accurately indicate the future state of the main gauge.

Once the vehicle enters the area with the new speed limit, the main indicators appear and move to meet the inner indicators.

From there the two sets of indicators move as one and continue to do so until the vehicle again predicts a imminent change in speed.

Click on any one of the screens to the left to launch an explanatory video of the relative speedometer.

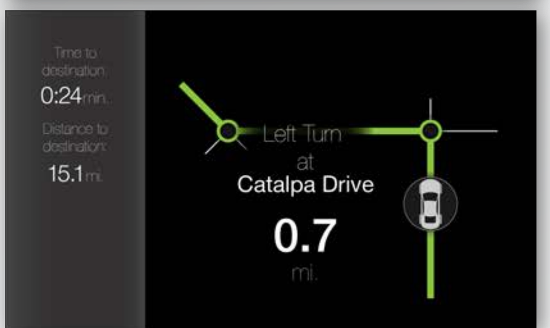


If you would like to see a clip of the in-vehicle testing, click on the projector icon.

After finalizing the primary design, I built a functioning version to implement in our prototyping vehicle. This version runs off of the real-time vehicle data and a second driver manually inputs the changes in speed limit to simulate GPS and navigation functionality.

The video isn't perfect as it is hard to get the exposure just right, but it gives a feel of what it is like to actually drive the display. The version being driven here is not the final but was an iteration during the refinement process of the design.

Heads-Down Display



Simplifying navigation

The navigation display is showing the vehicle, the route path of the next two turns and the important navigational landmarks leading up to the next turn. In this case: two intersections with stop lights.

As the driver passes the landmarks, they slide past the vehicle and disappear from the map. Allowing the map to be dynamic means that it can be optimized for clarity at all times. Here it obvious that the driver has passed through one intersection and has one more to go before he needs to prepare to turn.

Just as in a traditional navigation display, the driver always has the type of maneuver, e.g. turn left, the name of the next street, e.g. Catalpa Drive, and the distance to the direction.

Once the maneuver is completed, the map re-orients itself and populates the route with the navigational landmarks between the current position and the next direction.

The intent of the secondary display was to reduce driver workload by providing an interface that simplified the navigation experience, while making it more in line with the way that people get around in real life.

What this meant was to radically simplify the visuals of the map, while emphasizing the things that people use to navigate normally, e.g., stoplights, crossroads, bridges and stop signs. The scale of the displayed map is reduced to be no more than two steps of navigation and does not keep distances absolute, rather allowing them to change dynamically so the user can focus on the relevant navigation cues.

In addition to radically simplified content, the interface can be radically simplified as well as this display uses inputs from the central screen to allow a passenger to assist with input from the centrally located screen.