REDUCING DRIVER DISTRACTION CREATED BY THE INFOTAINMENT SYSTEM

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Abstract. *Driving an automobile is a high-risk task, thus there are multiple conventions signed by countries around the world to standardize aspects of cars to make them safer. However, none of these standards regulate the central control unit and the drivers' interaction with it. The article suggests that modern infotainment systems require too much of a driver's attention, despite not being a crucial part of driving. The text explores the drawbacks of modern multimedia systems, particularly the limitations of human interaction with touch screens. The article highlights the need to create a standardized multimedia system interface that is easy to use and habitual for the driver to reduce the need to take one's eyes off the road. The text proposes voice feedback and customizable tactile buttons, as an alternative to voice commands and flatscreens.*

Keywords: c*ar safety, tactile interface, voice feedback, habitual interaction*

Introduction

An automobile is an exceptionally high-risk object both for the driver and the people around them. To ensure that cars are not creating unnecessary risks for the population, countries around the world have signed multiple conventions that standardized as many aspects as possible to make cars safer. These standards cover aspects as rear-view mirrors, pedals, steering wheels, seats, headlights, taillights, body stiffness, airbags, wipers and turn signal stocks and even materials that can be used, but none of them states anything about the central control unit and the drivers' interaction with it. Modern cars have much more functionality than those that were present when the regulations were set: Music playback, A/C control, Navigation Systems and more. Most of those are only accessible through the car's Infotainment System. However, Infotainment System interfaces are not standardized, so they require much of driver's attention, despite not being a crucial part of driving.

Current implementations and their drawbacks

The main problem of modern multimedia systems - human interaction is the human itself, particularly the eye and its limitations and working principles. It changes the focal distance by modifying the shape of the lens inside the eye, which is ensured by the ciliary muscle that contracts or relaxes, thus changing the shape of the lens and its light refraction properties. When the eye focuses on infinity (the lens is at its flattest form) and the ciliary muscle is completely relaxed, it takes a certain amount of time for the ciliary muscle to contract and for the lens to increase its curvature and, respectively, decrease the focal distance. Hence, just focusing from the road to something in the car and back takes time and lowers the driver's attention to the road.

Over the last decade, the car industry has changed, moving toward touch screens as the center-stack control unit because it is a cheaper, easier-to-develop alternative for the traditional buttons and dials. A study from AAA Center for Driving Safety & Technology [1] shows that a modern multimedia system which includes a 17" center display and a 12.3" gauge cluster display, has voice controls and steering wheel buttons, on average, demands 23 seconds for a vocal command to be executed and the full attention of the driver to confirm it on the screen, and 26 seconds of full attention for the same task if done manually, and if we factor the maximum legal speed in Chisinau of 50km/h [2], a car will travel approximately 350 meters in this time, which is larger than the distance between

some intersections, thus generating a potentially high-risk situation that could lead to a crash and according to European Road Safety Observatory [3], distracted driving is the cause of between 5% to 25% of the road crashes.

Figure 1. Tesla Model S interior (17" center display and a 12.3" gauge cluster display, voice controls and steering wheel buttons) [1]

Since the first versions of touch-screen center stack implementation, the biggest problem was the lack of user-friendliness and low response speed, which were due to auto manufacturers having to do long series of testing of their products such as crash tests, endurance tests and performance tests, consequently, their touch-screens tend to be a couple of years older than the progress, at the release date. All these factors have made the big tech companies create products to enhance human-car interaction such as Android Auto [4] and Apple CarPlay [5], which use Bluetooth or wired connection to stream a different interface on the center-stack screen that is more familiar to the driver and can be controlled using Siri and Google, which are faster and more intelligent than the standard ones. Even though these assistants are better, they are not fully integrated and cannot do some basic tasks related to the car's controls, thus relying on the driver.

Possible solution: make a universal central stack unit that is easier to use

To alleviate the issues presented above, the Infotainment Interface must be standardized, to allow for a simple workflow. It should not distract the driver from the road, and be available on as many models as possible. The point of such a standard would be to make the interaction with the Infotainment System to become habitual. According to the study by J. Bermudes [6], to not lose performance, a skilled actor must neither focus on small parts of the action, nor lose the focus from the general action. I.e., a skilled driver does not contemplate every turn of the wheel, their actions are automatic, until they focus on something minute, or lose the focus on driving. Interaction with an unfamiliar Infotainment System can lead to both: taking one's eyes off the road, concentrating on the individual button presses. That is why as many cars as possible should include the same Infotainment System interface.

The need to take one's eyes off the road can be reduced in diverse ways. One existing solution is a Head-up display (HUD): A transparent information display projected directly onto the windshield. It still requires refocusing your eyes, but unlike a traditional Head-down display it leaves the field of view on the road, making it only a marginal improvement.(Figure 2) A widely available solution is a voice assistant. Today, many car manufacturers have custom Voice Assistant software, meaning that each brand has a different activation phrase, that a first-time user might not know. Accidental activation is also an issue, as shown in the research of I. Siegert [7] that can be a cause of frustration. Instead, we propose Voice Assistants activated via a button on the steering wheel.

Furthermore, Voice Assistants are not a universal solution. Loud environments lower the speech recognition performance, it may not understand the driver's language and accent. Also, there are drivers with speech impediments, or those who are unable to speak. A more accessible solution will not ask for voice input, but provide voice feedback. Even when an action can be done without looking, lack of feedback compels drivers to take their eyes off the road. Voice feedback would improve upon haptic feedback, which lowers lower distraction time, as proven by F. Quintal and M.

Lima [8]. This leaves us with 3 requirements: the solution should be standardizable; it should require as little visual distraction as possible; it should require only tactile input.

Touchscreens are becoming more popular in new cars, as seen in Figure 1. They only require finger presses and the UI on a graphic screen can be standardized. But they are distracting. Studies proved that nested menus on a flat screen require almost constant visual assessment, even with non-visual feedback added [9]. The solution would be to access the most used actions in a way that does not require looking at all. This can be done with regular buttons, with small ridges allowing for purely tactile navigation. We propose a way to keep the best of both worlds, flatscreen flexibility with reliable tactility – customizable buttons.

Tactile buttons with small screens behind them already exist, for example as stream decks (Fig. 2).

Figure 2. Elgato Stream Deck (example of a device with customizable tactile buttons) [10]

They can be easily navigated without looking, and changing the image on them allows for context-dependent actions or even shallow nested menus (Figure. 3). This means a new user can discern the position and action of each button quickly, but an experienced user, does not need
to take their eyes off the road for a wide range of actions. Backlit E-ink displays are a great candidate for use in car On-Board systems, as the screen does not require energy while it is not changing, and the backlight is not required in daylight.

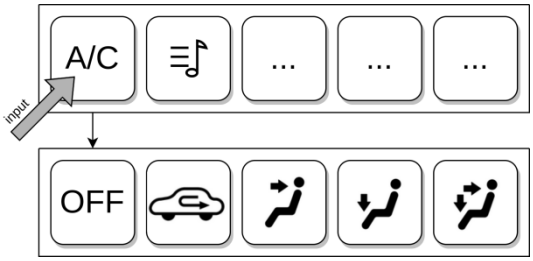

Figure 3. Example of a nested menu

Conclusions

Concluding all said above, we can affirm that it is crucial for the automotive industry to change and adopt new standards for the car central control unit, to minimize the time spent on completing basic tasks, to further minimize the instances of distracted driving that can lead to dangerous situations on public roads. These standards can include some of the proposed above solutions such as voice or tactile feedback and customizable buttons or come with new innovations that will make the human-car interaction more straight-forward and less distracting. Still, we cannot omit the already good implementations that exist in the car industry, such as heads-up displays and voice assistants, which with some improvements can largely lower the divers' interacting time with the central control unit.

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