Emotional Refuges, A Comprehensive Exploration of Esser in Redefining Autonomous Driving Experiences for Emotional Well-being

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ABSTRACT
This study addresses the transformation of vehicles into emotional sanctuaries, focusing on their role as spaces for intense emotional expressions.The article explores how cars can serve as dynamic tools for emotional regulation and expression. Highlighting the need for privacy in public environments, the exploration navigates through the complexities of integrating light and sound in prototypes that trigger immersive emotional experiences. The prototyping process is detailed, including the use of light to simulate emotional patterns, addressing the challenges and solutions encountered.

Authors Keywords
Emotional Experience; Immersion; Interactive Prototypes; Color Psychology; Emotional Sustainability; Automobile; Light Prototypes

INTRODUCTION
Autonomous driving has evolved beyond simple technological progression; it has become an opportunity to redefine the nature of the relationship between the individual and the vehicle. In this context, this article proposes a radically new perspective on the future of autonomous cars, moving away from their perception as mere means of transportation. Our vision starts from a bold premise: the car, specifically in the context of level 4 autonomous driving, can be conceived as an "Emotional Refuge."

This conceptualization transcends the mere function of mobility, embracing the idea that the car can be more than a vehicle; it can evolve into an intimate and immersive space. Where the connection goes beyond mere control, we explore the possibility that the car becomes an emotional sanctuary, a space where emotions are detected, embraced, and even transformed.

The need for this approach is evident in a society where daily life is increasingly hectic[1]. The car, instead of being just an autonomous vehicle, can be perceived as an ally that understands and responds to the driver's emotional state. This relationship can be particularly powerful in the context of autonomous driving, where the driver's mental freedom is enhanced, due not having to pay attention to the rout.

This article focuses on the category of emotional scenarios, considering the car as a refuge in situations of emotional intensity. We will address how the car can become a space for emotional embrace and transformation, using color psychology, light experiences, and other sensory elements to enrich this new dimension of the car-driver interaction.

With the aim of effectively synthesizing the various dimensions of this vision, we will focus on the challenges and solutions related to conceiving the car as an emotional refuge. Through a detailed analysis of prototyping and designing immersive light experiences, we will attempt to chart a path that transcends the mere technological function and explores the limits of how technology can emotionally integrate into our daily lives.

BACKGROUND

Cars as an Emotional Refuge: An Overlooked Opportunity
In the current research landscape exploring the relationship between emotions and driving, significant attention has been given to regulating emotions in the context of road safety [2,3]. However, a key opportunity may have gone unnoticed: the use of the car as a safe space for managing and transforming emotions.

Our interviews have shown that Generation Z raise awerness around emotional well-being [4,5]. Therefore it is crucial to explore how this generation perceives and

uses cars as areas for emotional management. In this context, we see that the car can be more than just a means of transportation; it can be a personal sanctuary, an intimate space for processing and modulating emotions.

We delve into the realm of personal experience through the words of individuals like Akanksha Deo Sharma, where she emphasize the need for safe spaces and how, in India, the streets become these safe spaces where one can transform with a stranger[6]. The needs of Generation Z for emotional well-being align with this notion of finding refuge and transformation outside the traditional realm of home or direct social interactions.

Through informal interviews and the collection of qualitative data[4], an interesting trend emerges. Those who own a car describe it as a place where they can process their emotions or even change them before heading elsewhere or returning home [4]. This pattern repeats in various situations: an incident triggers an emotion, and the person turns to the car, whether parked or en route, to process that emotion. The persons playlist emerges as a key element in this process, providing an auditory experience that facilitates reflection and emotional shifts.

In many cases, there is an evident need to return to an emotion considered "socially acceptable" before leaving the vehicle and heading to the next destination. The car, therefore, becomes a means not only of physical transport but also of emotional transport, allowing occupants to manage their emotions before reintegrating into the social sphere.

This dynamic can be fundamental in understanding how the use of the car as an emotional refuge can be a meaningful practice. With the observed patterns, the question arises: how can we transform this space into a conscious opportunity to improve emotional well-being intentionally? Delving into this question can open the door to innovations in car design and the creation of experiences that prioritize emotional management as an integrated part of driving and vehicle ownership.

CONCEPT

"Esser" captures the idea that the car transcends its function as a vehicle. It is an emotional sanctuary, an intimate space where we experience a full spectrum of emotions. This experience allows passengers to purge their emotions in a cathartic way, echoing traditions going back to ancient Grece and Aristotle's presentation of the tragedy as a place to let go of emotions before returning to the rational space of everyday environments[7]. This special relationship between the car and the driver, inspired by the connection between a tamer and their dragon, introduces us to a world where imagination knows no bounds.

The car, at level 4 autonomy, becomes more than a travel companion. It is an interactive stage that fosters communication and mutual learning. This small and secluded space transforms into a platform for profound sensory experiences, opening the door to a universe of possibilities.

CAR AS EMOTIONAL REFUGE: AN ANALYSIS OF THE IMMERSIVE SENSORY EXPERIENCE

Working with Scenarios

Approaching such a intricate concept, characterized by multiple possibilities, requires meticulous structuring. From the beginning, the need to focus on three categories of scenarios was established: Functional(A), Emotional(B), and Fantastic(C), with the goal of effectively synthesizing their various dimensions.

The theme of the emotional scenario is the central core of the article; therefore, we will set aside the other two scenarios.
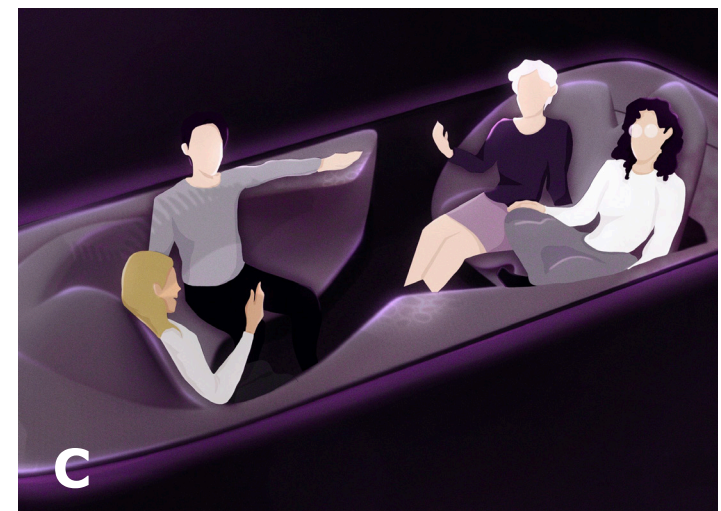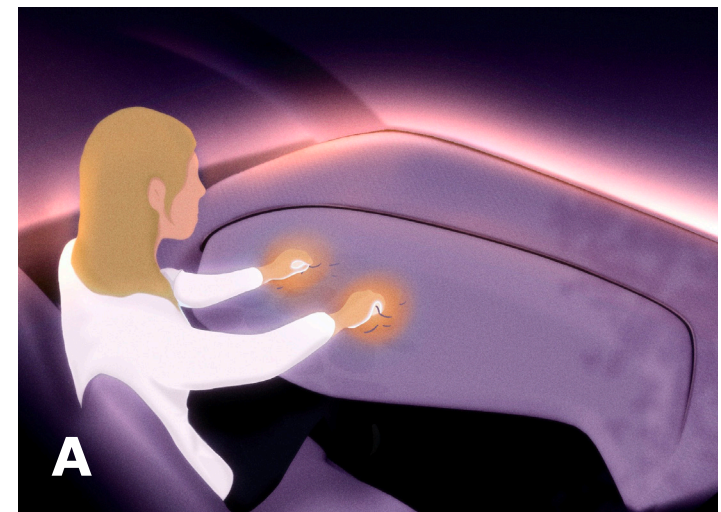
The Car as an Emotional Refuge:

In this scenario the car becomes an emotional refuge, acting as an ally in this transformative journey. When you experience an intense emotion upon entering the car, it is detected(F), opening a dialog to check if that is the emotion that you are feeling and in cas it is offering you the option to embrace it.

Prioritizing embrace over transformation, you can create an immersive interior environment through the lighting and your playlist, adjusting the sound space, or the ambiance. At times, when seeking an emotional change or tranquility, the car emerges as an essential support. To facilitate emotional transformation, the car uses stored sensory memories, such as music that was saunding in that moment, the smell, the wheather outside or the emotional bit of the nigth. although the details of this process are not explained in this article.
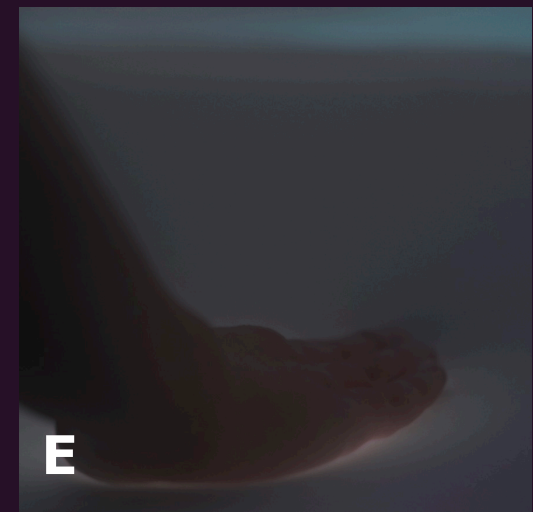
Let's delve into an illustrative example by following the journey of Nuria, a 28-year-old full-stack developer from Girona, Spain, who relies on her car for daily commutes to and from work.

Nuria has just experienced a challenging day at work, filled with endless meetings and a slew of bugs to resolve. Feeling notably frustrated, she steps into her car, equipped with an innovative system called Esser. This intelligent system begins to sense her emotions, quickly detecting her frustration (D,E). Engaging in a dialogue with her, Esser confirms her emotional state and proposes options: Nuria can either embrace or transform this emotion. Opting to embrace it, Nuria triggers a transformative experience within the car's environment.

The atmosphere shifts dramatically, adopting a vivid red and green color palette that envelops her, creating a heightened tension in the environment and increasing her heart rate. Simultaneously, a curated playlist, developed over time between Nuria and Esser, emerges to fully immerse her in the cathartic experience. (F,G)

As Nuria enjoys this emotional release, Esser, being aware of an upcoming important event, reminds her that she is meeting her partner's friends today. Deciding to transform her emotions to confidence for this social gathering, Nuria commands Esser accordingly.

In response, the entire environment undergoes a profound change, transporting her back to a cherished memory. The car's interior mimics the setting of a previous drive with her girlfriends to a memorable party. The same music plays, familiar scents fill the air, and the emotions of that moment envelop her. Nuria finds herself reliving the joy and radiance she experienced during that particular drive, setting the stage for a positive and confident state of mind as she heads toward her destination. (H,I)

Designing a Sensory Experience

Creating a sensory atmosphere involves the meticulous interconnection of elements for a meaningful and transformative experience, maintaining a delicate balance between richness and simplicity to avoid user saturation. Aspects such as music, sounds, colors, flashing lights, and projected patterns blend harmoniously. Introducing simultaneous tactile elements, such as temperature changes, vibrations, movements, and textures, can further enrich the experience, although caution is needed to prevent excessive layering.

In this sense, we have selected light and sound as central elements, inspired by Antoni Arola's "Oasis (archive of skies)" [8](J), who elegantly used these two components to create a remarkable impact. Although the experience also includes tangible elements (especially linked to the study of the living vehicle), it has been crucial to design both parts of the experience together. We will mainly focus on how to design the intelligible sensory experience and, therefore, will not mention the tangible part.

Working with Emotions

The creation of this sensory experience involves a diverse spectrum of emotions, and to

address it in detail, we have chosen to focus on a specific scenario. We have designed a small context where a person arrives at the car frustrated after a challenging day at work. This initial emotion is embraced in the first phase and transformed into another, confidence, as the person has a romantic date.

To select the two key emotions, we have used the emotional circle (k) and explored feelings of high negative intensity, especially steering away from toxic positivity. [9] Frustration emerged as an interesting choice, as it is not widely socially accepted but is highly present in our daily lives. The second emotion, confidence, was chosen considering its transformative power and as a justified shift in the context of a first date, seeking to avoid the pitfalls of forced positivity.

In addition to the emotional circle, we used the app "How Do I Feel," [10] which categorizes emotions based on intensity and polarity (L), providing a comprehensive view of emotional possibilities. It is worth noting that, although we considered other emotions, we primarily focus on this specific scenario to analyze how the enviroment that Esser facilitats help the user to manage and transform these emotions, so we could design more thought thru deep detaild interactions.

SENSORY DESIGN: THE LIGHT PLAY THAT TRANSFORMS EMOTIONS

Light and color psychology are key elements in creating these emotional spaces. Color psychology, widely used in other fields such as media and comunication, has been integrated into this sanctuary space we are developing. *Essɐr* consists of three main lights, aiming to not overwhelm the user and creating an elegant, effective, and impactful environment.

Interactive Lights (M,N)

This light surrounds the interior and serves for communication between the *Essɐr* and the user. The lights focus on our front during interactions. In moments of emotional exploration, they extend throughout the car, offering complete immersion. Animations are gentle and limited, avoiding overstimulation unless they serve a clear purpose, such as indicating a specific emotion.

Decorative Lights (O,P)

Small lights that traverse the interior scales, providing an aesthetically pleasing look and contributing to the overall mood without directly impacting the user.

Immersive Lights (Q,R)

The car's ceiling emerges as a unique lighting experience, capturing the inner skies of emotions. With the premise of using personal memories to transform feelings, the ceiling responds with brief illumination upon detecting an emotion. When choosing to embrace this emotion, the ceiling lights up with a light pattern reflecting the complexity and intensity of the chosen emotion.

Light Interactions

Light interactions establish a fluid dialogue between the user and the Essɐr, incorporating a deeper understanding of emotions. Using biometric readers such as facial recognition, heart rate, and skin temperature, the car identifies indicators of negative emotions, initiating a continuous learning process between the vehicle and the user[11]. Upon entering the car, it subtly adjusts the lighting in front of us or on the ceiling, asking if this change reflects our emotions. If we confirm this emotion through gestures, we are given the option to ignore it, embrace it, or transform it.

Choosing to embrace the emotion involves a complete immersion through lighting and music. Small lights pulsate gently along the belt, offering a subtle sensation, while the emotional pattern comes to life on the ceiling, enveloping the user in this luminous state. When deciding to change emotions, the car refocuses attention, activating a lighting sequence in front of us and offering the possibility to pivot towards other emotions, such as confidence. Thus, the car adapts the ceiling pattern and illuminates the interior with the newly chosen emotion, in this case, using a past memory to assist you in this transition.
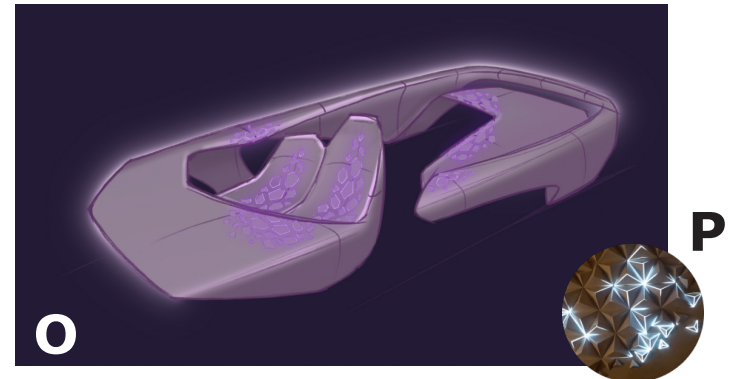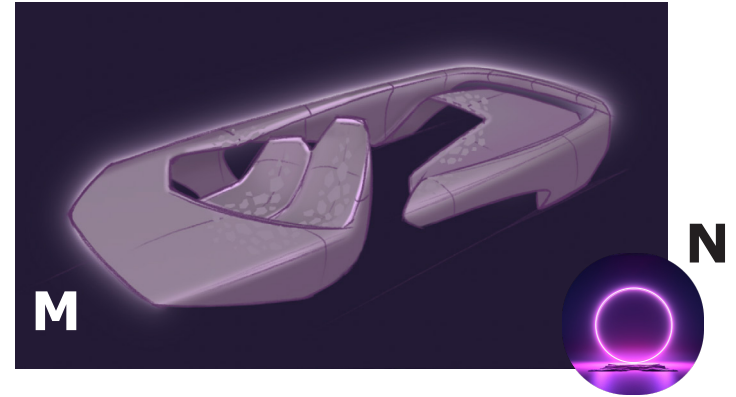
Challenges in Exploring Light Design

One of the highlighted challenges of this project revolves around the intricate subtleties of light prototyping. The complexity lies not so much in how it will be perceived but in how this immersive experience can be experimented with before a full implementation involving LEDs and code. Navigating between various prototyping tools and carefully considering their advantages and disadvantages was crucial to addressing this challenge.

In the early stages, using digital drawings[12] with Procreate provided a static view of the light schemes(V), emphasizing their arrangement and quantity. However, this methodology was not effective enough to visualize the roof light, prompting the need to focus on other approaches.

Roof Prototyping (the sky): (S,T)
To address the complexities of the roof, a physical prototype(S,T,X) was explored that mimicked the effect accurately. Through a basic model of the vehicle and animations reproduced on an iPad, an inside perspective was provided on how the light would impact different areas of the car and how this pattern would be experienced from inside the vehicle.

Animation Exploration:
Developing animations for the other two lights posed a significant challenge. Initially, the use of physical prototypes was considered but dismissed as impractical at this stage. Alternatively, tools such as Procreate for 2D animations and 3D software like Magicvoxel(W) for static lights were explored, despite presenting certain limitations.

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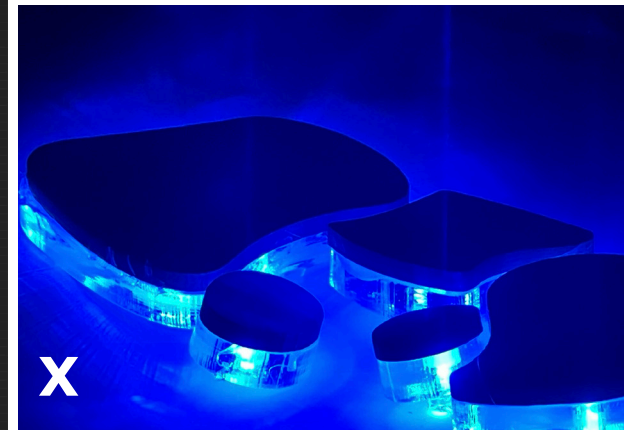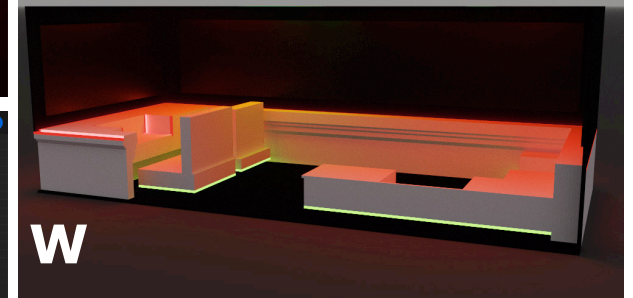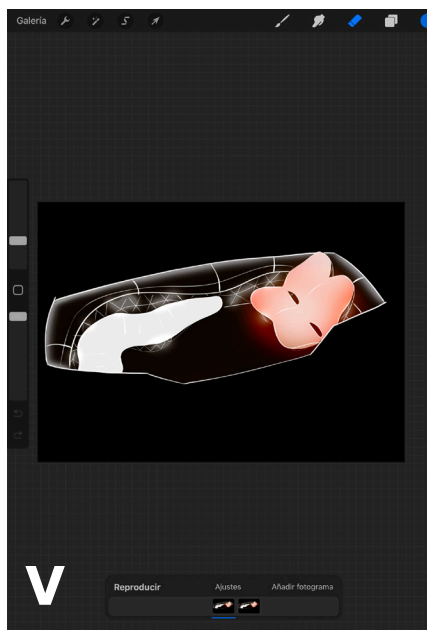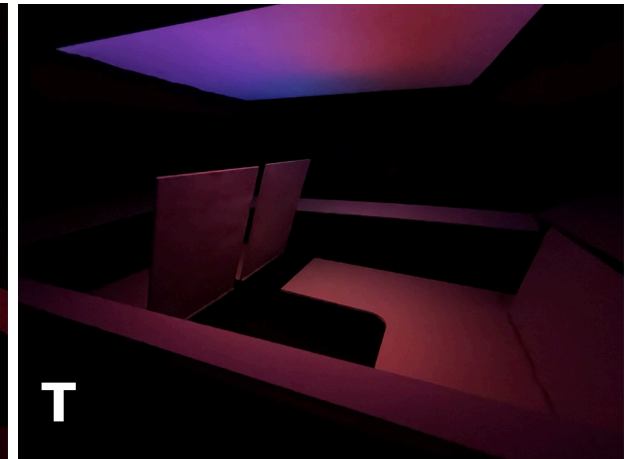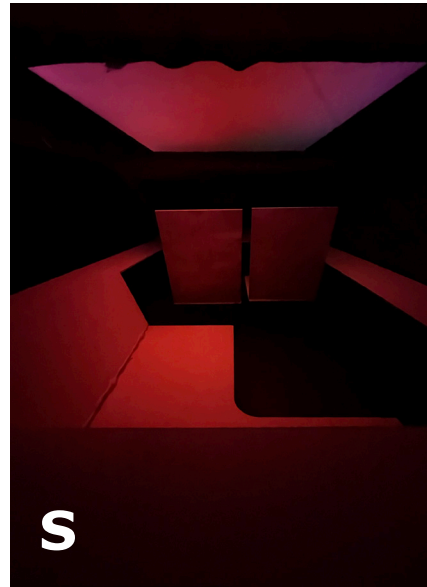
After evaluating various options, After Effects(U) was chosen for the animations as it allowed for quick prototyping and experimentation with different ideas. Integrating layers of the roof and animations, this tool offered a detailed and flexible visual representation.

The process involved a deliberate rejection of using 3D software like Blender or Maya since creating a sufficiently advanced model of the car's interior was unattainable at this stage. The final approach with After Effects, using a sketchy perspective, allowed for agile experimentation and a fully communicative visualization of the concepts.

Although not fully explored, the potential use of virtual or augmented reality for a more immersive visualization was considered, leaving this option open for future developments. In summary, light prototyping was approached with creativity, combining digital sketches, physical prototypes, and tools like After Effects to provide a vivid understanding of the vision before moving on to more detailed prototypes.

**Refined Prototypes: Challenges and Approaches**
In order to effectively convey the concept, we undertook the creation of two prototypes for our car project. One, at a 1:1 scale, allowed us to firsthand experience the ambiance, while the other, a 1:10 scale model, showcased how the environment could be modified distinctly.

1:1 Scale Model
We constructed this model to experiment and record large-scale changes in lighting and tangible interactions. Using a canvas and a projector, we visualized animations on the ceiling, creating diffusion for the impact of light on surfaces while maintaining animation clarity(Y,Z). However, we later realized that the canvas was not sufficiently translucent to allow light passage. Consequently, we decided to place a television screen in front with the animation open to achieve the desired light effect. Additionally, we programmed a strip of 166 LEDs with ambient light animations to experience not only small interactions with the dashboard but also their effects on the overall environment.(α,β)

γ

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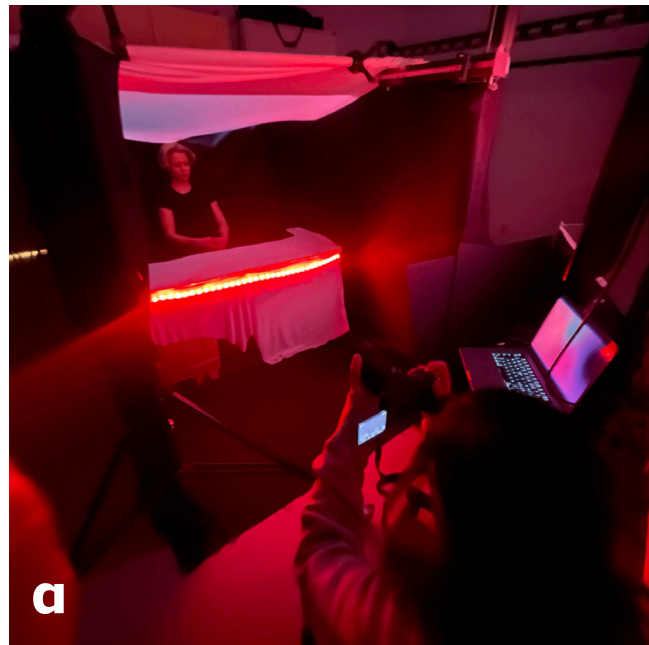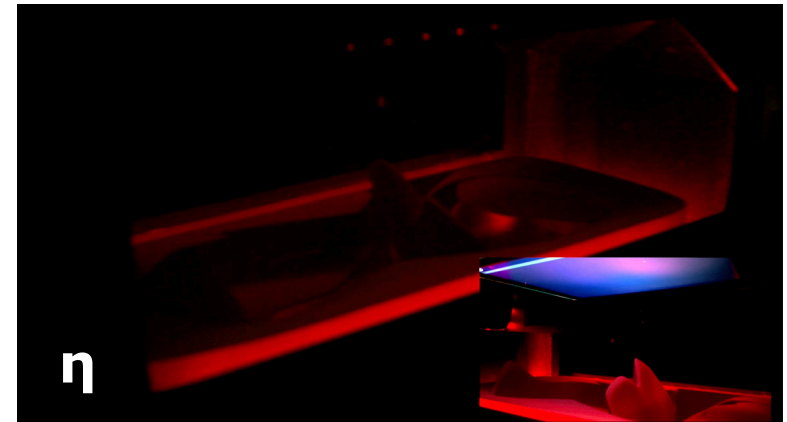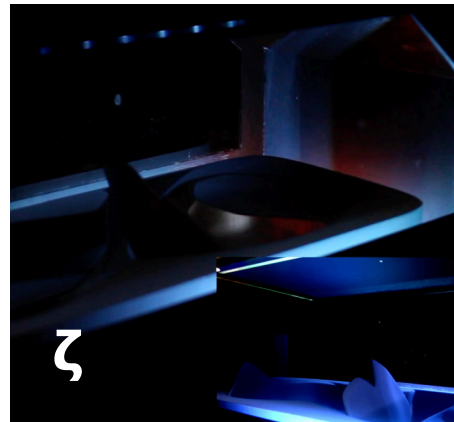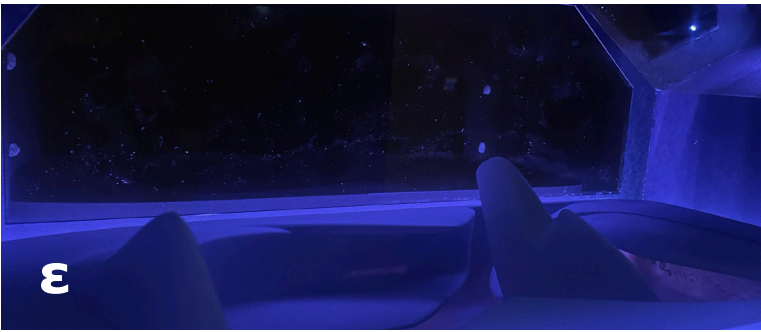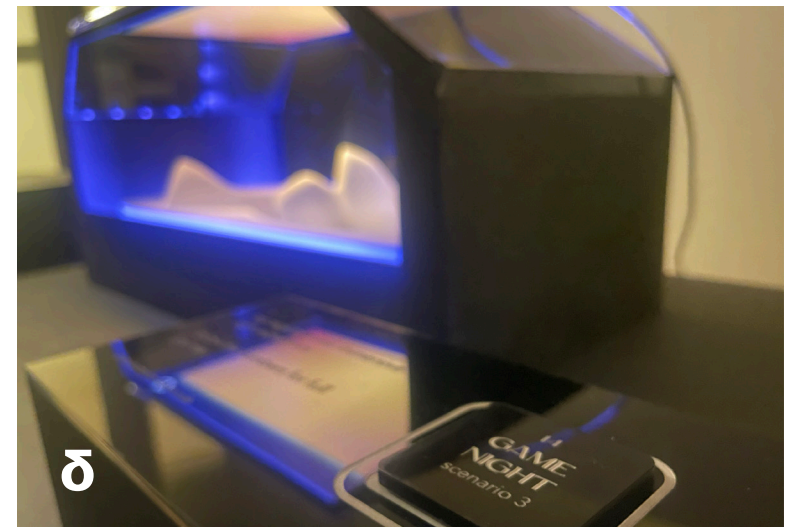
1:10 Scale Model

For the smaller-scale model, we 3D-printed a minimally detailed car, sanded it, and filled it with filler to create a smooth, imperfection-free surface (γ, ε). We designed a box around it with a shape resembling the car but not replicating it, providing enough support for an iPad. In this model, our goal was to showcase polished light interactions, so we attached a strip of 36 LEDs to the floor, encircling the car. Using the Neopixel library, we programmed various scenarios focusing on refined light interactions. Additionally, we left space on the ceiling to connect an iPad, mirroring the screen of a computer connected to a programmed website containing different ceiling animations(η). To display all possible interactions, we programmed RFID tags on the LED strip for small-scale interactions and the website for ceiling scenarios(δ,θ,ι). These messages were sent simultaneously to the Arduino program, activating different LED sequences and the website through serial communication, enabling the activation or deactivation of various videos.
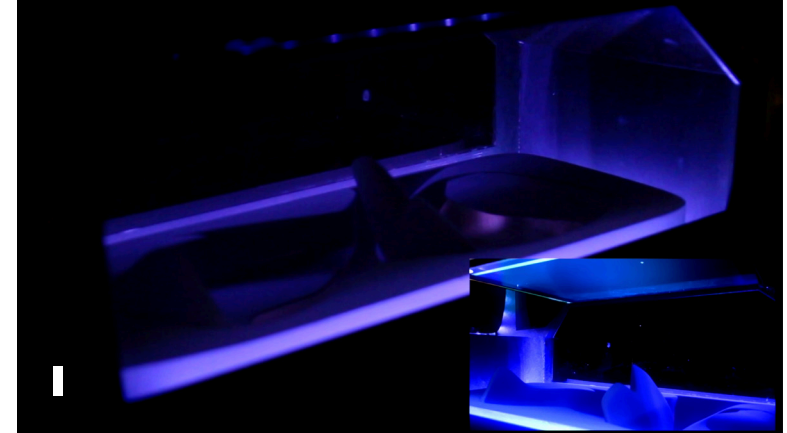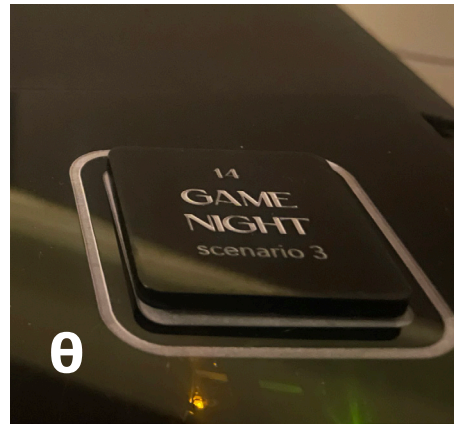
CONCLUSION

In conclusion, our exploration of the "Esser" system has reimagined the role of cars as emotional refuges, challenging traditional views of autonomous driving. The need for emotional sanctuaries in our fast-paced society is evident, especially among Generation Z.

Focusing on emotional scenarios, we delved into Esser's design elements, emphasizing light and sound for immersive sensory experiences. Nuria's journey exemplifies the potential impact on daily well-being during commutes.

Our proposal envisions cars as interactive stages, fostering communication, learning, and emotional well-being. Esser encapsulates this vision, offering users a transformative journey within their own vehicles.

As we stand at the intersection of technology, emotion, and design, we invite the industry to embrace integrating emotional well-being into autonomous driving. The car, once a means of transport, can become a haven where emotions are acknowledged, celebrated, and transformed. This journey signifies a paradigm shift and exploration of boundless possibilities when technology intertwines with the human experience.

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