CONNECTED CAR EXPERIENCE

FOR AUTONOMOUS VEHICLES

INTRODUCTION

The aim of this project was to **study user behaviors by designing future experiences for the autonomous car of the future.**

The project explored multiple factors that would affect the adoption of these vehicles, the highlight being- Trust as the major factor enabling or disabling the adoption of these in large scale.

The outcome of the project was design recommendations for an application design that will act as a bridge to building user trust.

Project Assumption: The Infrastructure of our cities will enabled through wireless technology (V2X) in order to support them for the daily commute.

PROCESS

RESEARCH

USER STUDY WORKSHOP

CONTEXTUAL INQUIRY- RIDE ALONG + OBSERVATION EXERCISE

ANALYSIS

PERSONA CREATION

CURRENT USER JOURNEY MAPPING (5E)

OPPORTUNITY MAPPING

USER JOURNEY MAPPING FOR FUTURE (5E)

TASK ANALYSIS

FEATURE DESIGN

INFORMATION ARCHITECTURE

EXPERIENCE DESIGN

EXPERIENCE MAPPING/ DESIGN IDEATION

APPLICATION DESIGN

WIREFRAMES

STORYBOARDING

PROTOTYPE TESTING

TESTING AND FEEDBACK

FINAL DESIGNS

DESIGN REFINEMENTS BASED ON USER FEEDBACK

PROJECT REFLECTIONS

RESEARCH

This phase focused on understanding user behaviors, expectations, and challenges regarding autonomous vehicles.

Activities:

1) Contextual Inquiry: Ride-alongs using Tesla Model X and Acura MDX (Level 2 autonomous vehicles) to observe current autonomous driving experiences and rider-driver behaviors.

2) Interviews: Gathered insights from participants post-ride-along and prototype interactions.

3) User Study Workshop: Participants interacted with a low-fidelity prototype of a driverless car and a virtual assistant, both individually and in groups.

Outcomes - Key Insights:

+ Users struggle to **trust** fully autonomous vehicles.
+ Concerns over **privacy** when sharing data within the vehicle.
+ User behaviors and interaction modes differ when alone versus in groups.
+ Desire for more insights into the vehicle, its operations and functions and enhanced **interaction with the vehicle for extended functionality.**

RESEARCH - USER STUDY WORKSHOP

"In addition to the experiences in the car, I want an application on my phone/tab which helps me to interact with my vehicle in real time, when I am outside too. I want it to not only replace my car keys, but access more functionalities."

Task:
Multiple individuals from different backgrounds (car owner, commuter, occasional driver) were invited to participate in the experiment.

We provided the participants with a low fidelity prototype of a driverless car interior and a virtual conversational assistant. Their task was to interact with the prototype individually and in groups and provide feedback.

Outcome:
The experiment helped us to better understand:

1. The expectations of users regarding the functionality of an intelligent vehicle as well as usability and modes of interaction.
2. Change in user behavior and interaction with the system when alone versus with company.
3. Concerns of the user about privacy while sharing and viewing data on the vehicle's system, and effect of the presence of another individual.

RESEARCH: RIDE ALONGS, OBSERVATION, INTERVIEWS

In collaboration with the UX researchers on the team, we did a contextual inquiry using Tesla Model X and Acura MDX, which were offering Level 2 Autonomous driving.

We did this to understand the current experience of autonomous driving and gain insights about the interaction design trends for such vehicles.

We did a ride along to observe the rider driver behaviors. We then interviewed the the riders to understand their experiences, perspectives and baseline expectations.

"Even though the car is driving itself fine, it is really hard to trust it, keep hands off the wheel, and watch the steering wheel move itself. Feels unnatural."

ANALYSIS

This phase involved synthesizing research findings to identify opportunity areas and create user-centered frameworks.

Activities:

1) Persona Creation: Developed multiple personas to represent diverse user scenarios; chose “Matt,” an early adopter, for detailed exploration.

2) User Journey Mapping: Mapped current commuting experiences using the Compelling Experiences Framework (5E: Entice > Enter > Engage > Exit > Extend) to identify gaps and opportunities.

Outcomes:

Mapped gaps in the current user journey to uncover opportunities for:

+ **Building Trust:** Highlighting how transparency and user control could mitigate trust issues.
+ **Simplifying Interaction:** Reducing the cognitive load for users through intuitive design.
+ **Enhancing Control:** Creating options for users to intervene or interact with the vehicle in meaningful ways.
+ **Improving Connectivity:** Enabling seamless vehicle interaction through a connected mobile application.

ANALYSIS: PERSONA DEVELOPMENT

Early Technology Adopter Persona:

The persona created for the project was **Matt**, representing an **early adopter** of autonomous vehicles.

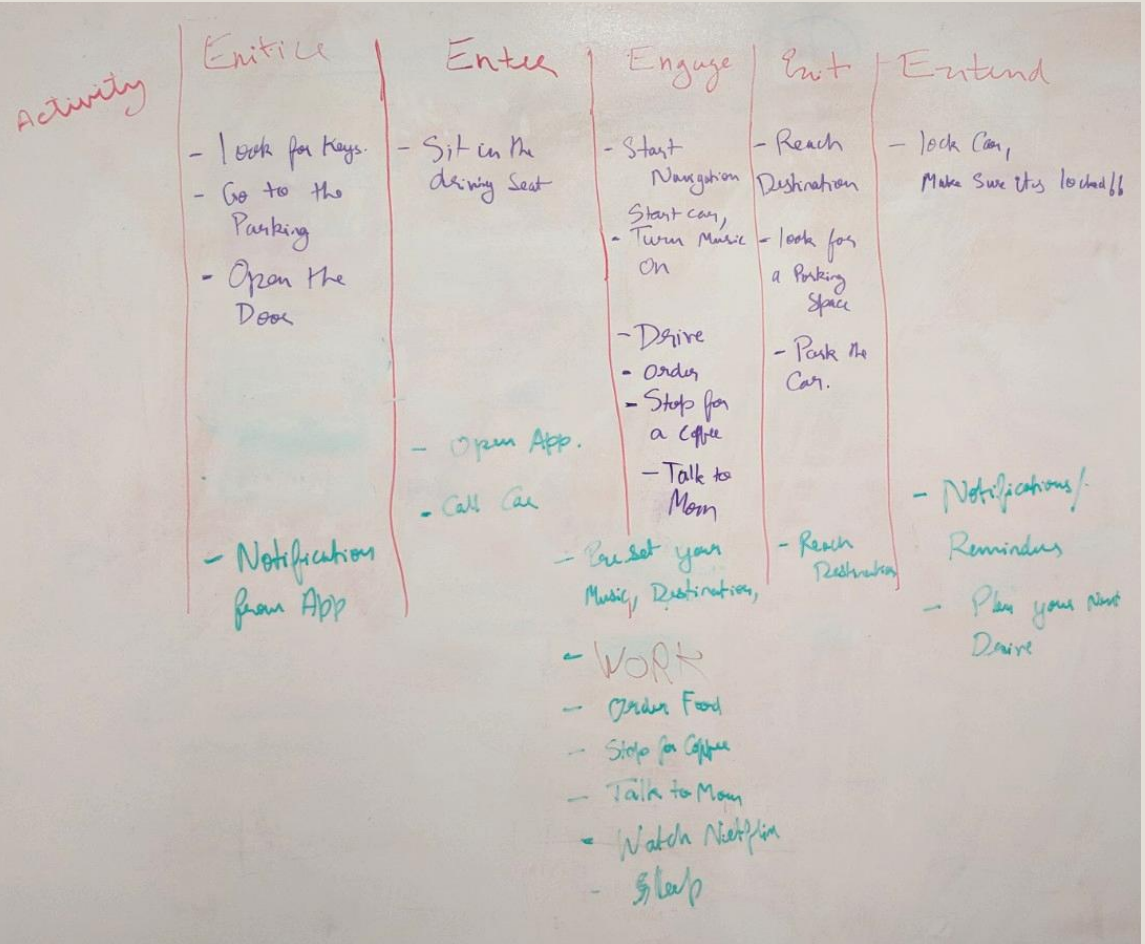
Matt served as the focal point for designing and testing use cases for the autonomous vehicle.

His persona helped to align the features and application design with the needs and challenges faced by early adopters of this technology.

Age: Late 30s (in the year 2030)
Profession: Works at a tech company in California
Needs: Daily commute from home to work using a fully autonomous vehicle.

Lifestyle and Behavior:
Commutes alone most of the time.
Regularly spends around two hours commuting.
Prefers leaving home early to avoid traffic.
Utilizes commute time for productivity or completing daily chores.
Expectations:
A seamless and trustworthy autonomous driving experience.
Tools and features that simplify the morning rush and enhance productivity during commutes. Real-time interaction with the vehicle even when not inside it (e.g., via a mobile application).
Goals:
Use his commute efficiently to save time for other personal and professional activities. Have an intuitive and user-friendly interface for controlling the vehicle.
Feel secure and in control while using an autonomous vehicle.
Pain Points:
Trusting the vehicle's autonomous capabilities, particularly during critical situations.
Finding it unnatural to fully relinquish control of the vehicle.
Concerns about privacy and sharing data while using connected features.
Navigating the transition from manual driving to fully autonomous systems.

ANALYSIS: CURRENT USER JOURNEY MAPPING



COMPELLING EXPERIENCES FRAMEWORK:
Entice > Enter > Engage > Exit > Extend

Using the compelling experiences framework and insights from the user study workshop and ride alongs, we were able to map the current user experience of commuting.

This user journey will help us identify the opportunity points to enhance the user experience in the design phase of the project.

(DIGITIZED VERSION IN THE NEXT PAGE)

ANALYSIS: CURRENT USER JOURNEY MAPPING

Phase	Entice	Enter	Engage	Exit	Extend
Activities	- Look for keys - Go to the parking area - Open the car door	- Sit in the driving seat - adjust the seating if it is a multi-use vehicle in the family.	- set up the device connections - Open the phone applications if needed - Start navigation - Start the car and drive - Turn on level 2 driver assist - Perform secondary activities: >Place delivery or other orders or make a pit-stop for a coffee or other chores. - Call family/friends	- Reach the destination - Look for a parking space - Park the car	- Lock the car - Ensure it is securely locked (confirmation)
Pain Points	Time spent locating keys.	Setup time for the car systems everytime, if it is a multi-use vehicle.	Multitasking while driving may reduce focus even with level 2 autonomous driving. Multi device interactions are cumbersome and feel disjointed Limited user trust in inbuilt navigation or vehicle responsiveness.	Time and effort spent finding suitable parking. Manual intervention for parking breaks the experience and might reduce trust in autonomous systems.	Insecurity about whether the car is fully secure. Limited interaction with the car once the user has left the vehicle

KEY LEARNINGS

Based on our research, we identified the following eight user-centered insights that guided the design principles of solution design.

1. **Need for Trust and Transparency:**
Users need to feel that they can trust the autonomous vehicle's technology, necessitating features that enhance transparency, such as real-time monitoring and detailed control over vehicle settings.

2. **Desire for Control:**
Despite the vehicle's autonomous capabilities, users want to maintain a sense of control, leading to features like route customization and manual override options.

3. **Privacy Concerns:**
Users are concerned about the privacy of their data and interactions within the vehicle, prompting the inclusion of secure data handling and privacy protections.

4. **Seamless Connectivity:**
Users expect to interact with their vehicle as easily as they do with other smart devices, requiring a seamless connection between their mobile devices and the vehicle.

5. **Intuitive User Interface:**
The need for an intuitive and easy-to-use interface is critical, as it reduces cognitive load and makes the technology accessible to all user demographics.

6. **Enhanced Security:**
Security is paramount, not just in physical terms but also in data protection, leading to features like digital keys and confirmation of vehicle security.

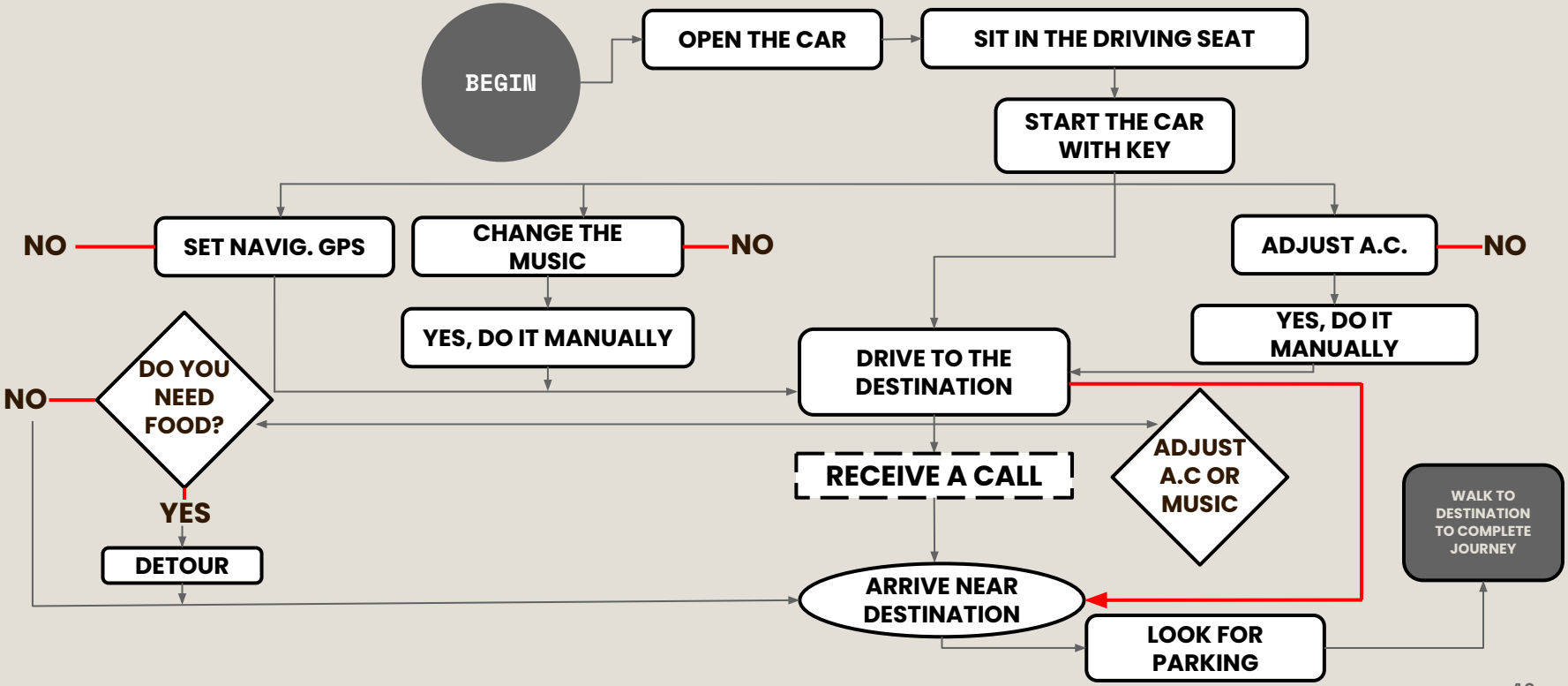
7. **Multimodal Interaction Preferences:**
Different users prefer different interaction modes (voice, touch, tactile), necessitating a flexible system that accommodates various preferences.

8. **Optimization of Commute Time:**
Users want to utilize their commute time effectively, whether for productivity or leisure, which is addressed through in-car entertainment and connectivity features that support multitasking.

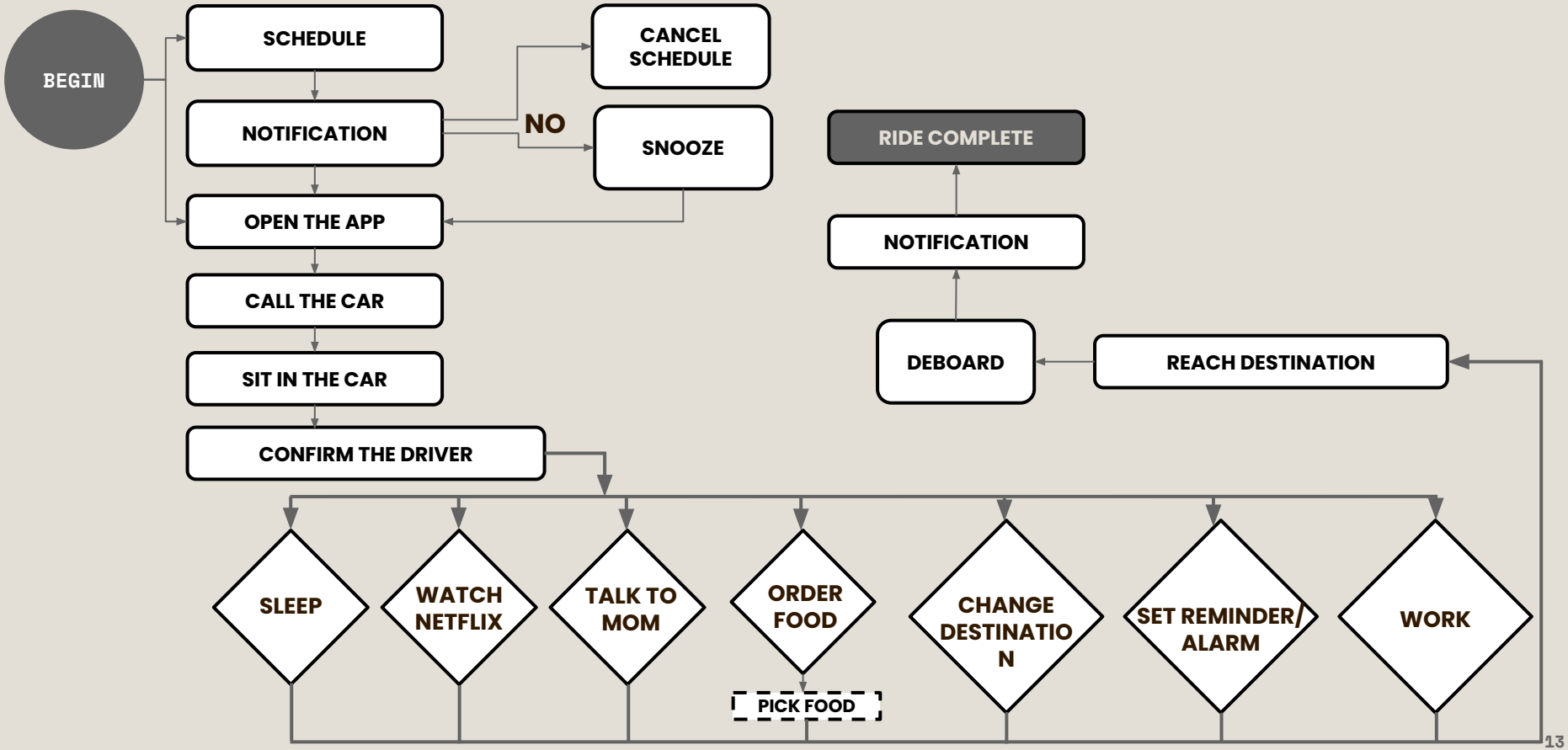
TASK ANALYSIS AND INFORMATION ARCHITECTURE:

Deriving from the framework exercise used earlier we did the task analysis of the current scenarios of commuting - 1) When driving 2) When taking a ride-share

CURRENT SCENARIO - When driving own car:

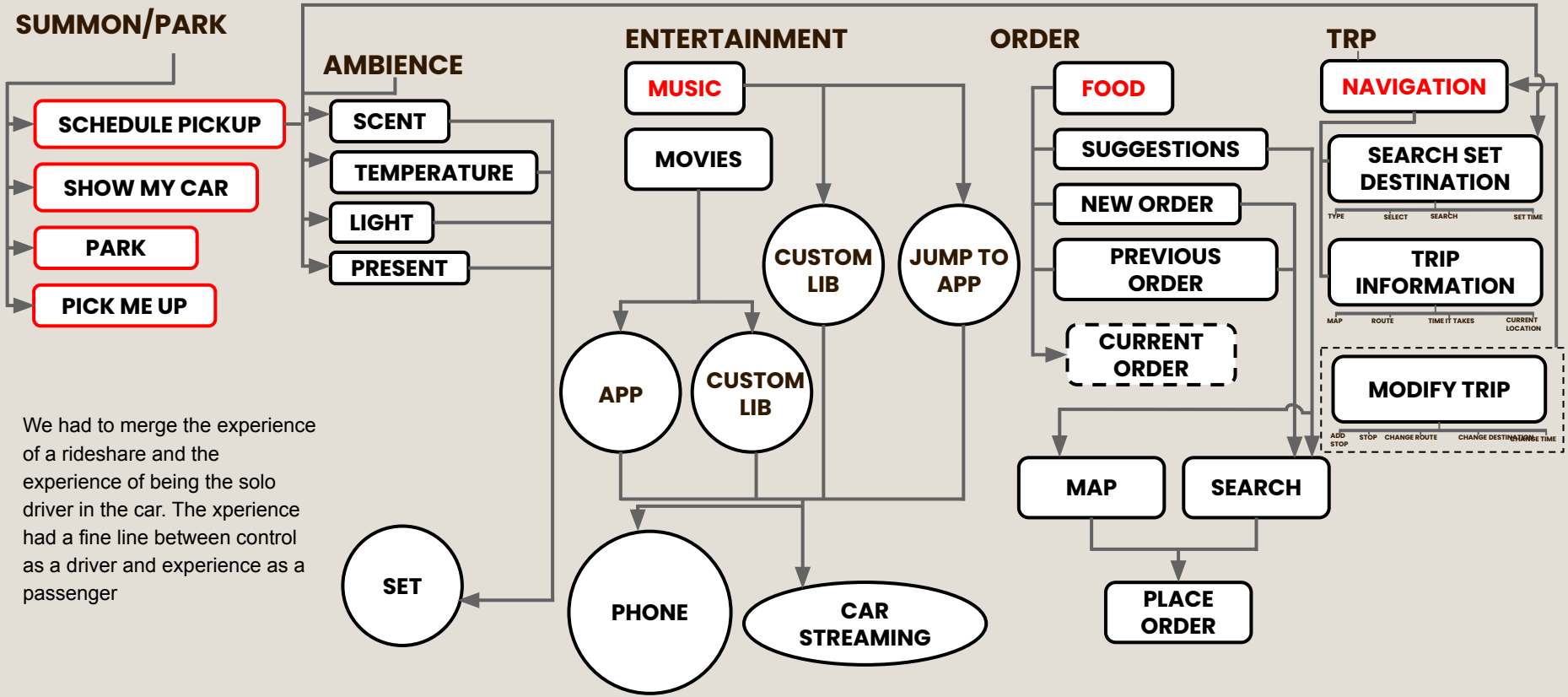


CURRENT SCENARIO - When driving own car:



FUTURE SCENARIO:

Information architecture for the mobile application integrating the whole experience and services together:



We had to merge the experience of a rideshare and the experience of being the solo driver in the car. The xperience had a fine line between control as a driver and experience as a passenger

Design Principles

In this phase, we identified potential areas where the user experience of autonomous vehicles could be enhanced. Design Principles served as a bridge between research and design ideation, ensuring that all ideation was grounded in real user needs and expectations. It helped prioritize features and informed key aspects of the final application.

A set of clearly defined opportunity areas/design principles to guide the design phase:

Addressing the inherent trust deficit users have in autonomous vehicles - The need for real-time vehicle monitoring and route customization.

Ensuring **users feel in control**, even in an autonomous environment.

Systems for **clear communication** between the vehicle, user, and environment (e.g., multimodal feedback).

Seamless Integration Across Platforms - allow users to connect with their vehicle anywhere, anytime.

KEY FEATURES OF THE APPLICATION

Real-Time Vehicle Monitoring: Users could monitor their vehicle's status and location in real-time, enhancing transparency and trust.

Route Customization: The application allowed users to customize their routes, giving them greater control over the vehicle's navigation.

Remote Vehicle Interaction:

+ Summon/Park: Users could summon the vehicle to their location or send it to park with just a few taps on their application.
+ Vehicle Settings Adjustment: Users could adjust settings like ambient lighting, temperature, and entertainment preferences remotely.

Enhanced Security Features:

+ Digital Key Functionality: The application replaced traditional car keys, allowing users to lock and unlock their vehicle through their mobile devices.
+ Confirmation of Vehicle Security: After parking, the application confirmed that the car was securely locked.

Multimodal Interaction:

+ Voice, Touch, and Tactile Inputs: The system supported various modes of interaction including voice commands, touchscreen inputs, and tactile feedback from the vehicle.

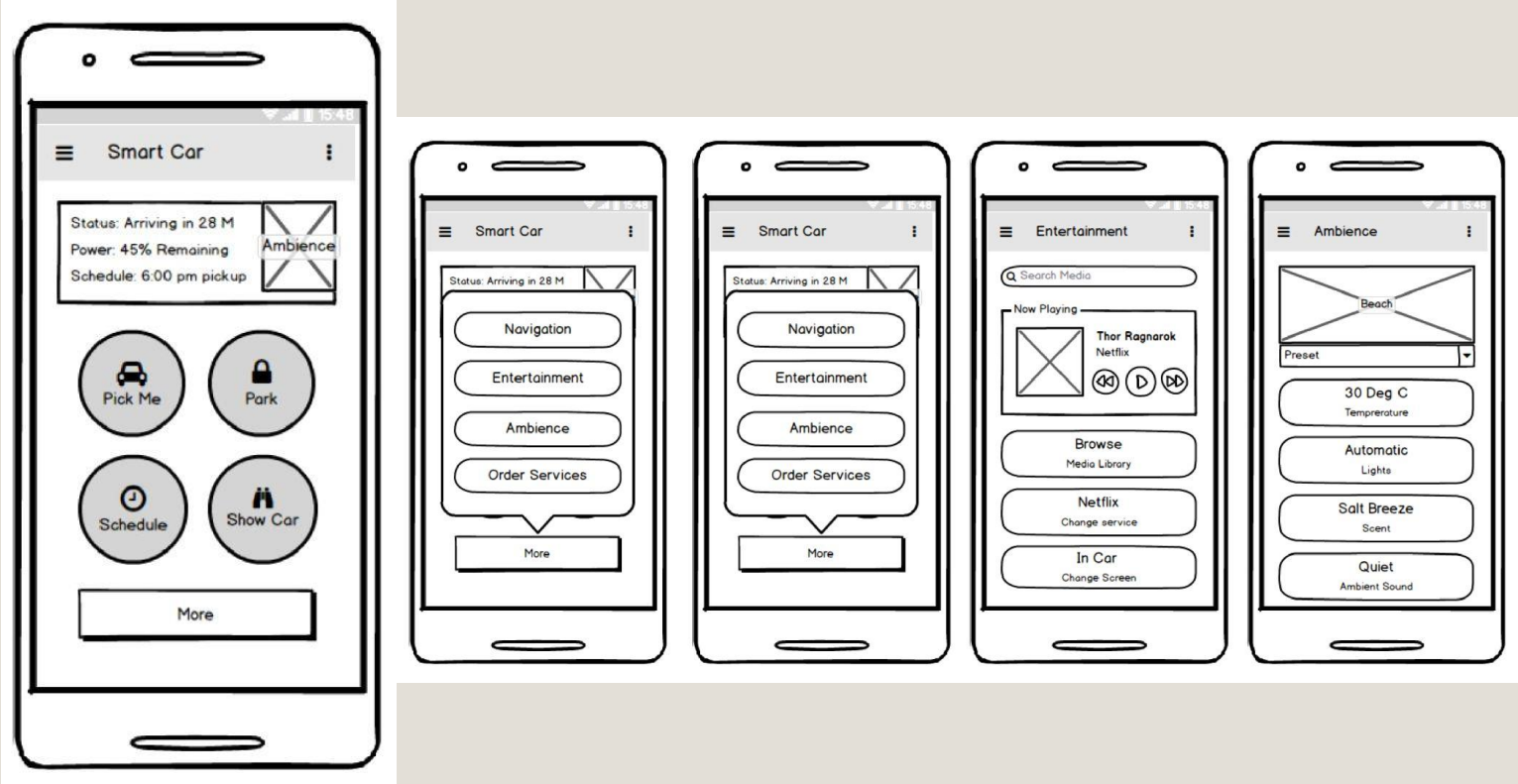
User Assistance and Alerts:

+ Automated Assistance: Integration of a virtual assistant to help with navigation, settings, and other functionalities.
+ Safety Alerts and Notifications: The application provided important notifications and safety alerts to ensure the user was aware of any critical information or changes in the vehicle's operation.

Entertainment and Productivity:

+ In-car Entertainment: Users could control music, movies, and other media directly from the application.
+ Work and Leisure Activities: The system was designed to support activities like online meetings or watching media during commutes, maximizing the usability of travel time.

APPLICATION DESIGN | WIREFRAMES:



FINAL STORYBOARD DEPICTING THE FUTURE SCENARIO AND APPLICATION IN USE

APPLICATION DESIGN | STORYBOARD

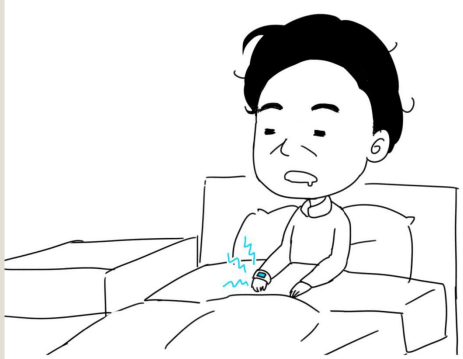
It’s the year 2030, Matt is in his late 30s, works at a Tech company in the state of California and has an fully autonomous vehicle car and uses it to commute from home to work on daily bases.

His usual travel time is two hours and prefers to leave early from home to avoid traffic. Like most other people he’s always in a rush in the morning.

He usually travels alone and prefers to do some of his daily chores on his way back to work and back home.

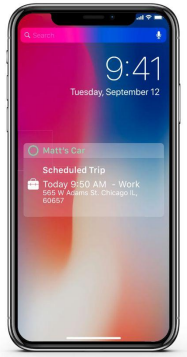
01

Wakes up in the morning...!!



02

Making breakfast when he confirms the trip...

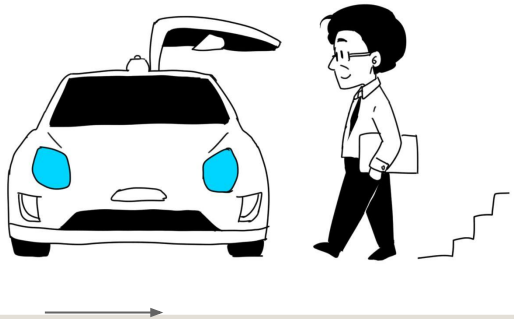


03

Making breakfast when he confirms the trip...

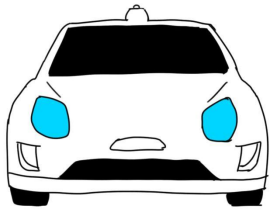
04

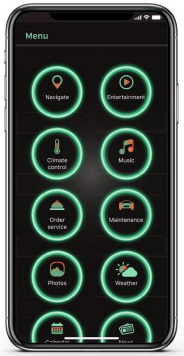
The door opens automatically...
Matt walks into the car



05

Interface on smartphone changes when he enters the car...





06

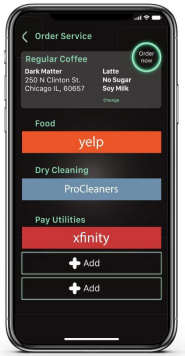
Sets his favorite music...!!

07

Sets the temperature....

08

Suddenly feels thirsty, Orders his cup of favourite coffee...!!

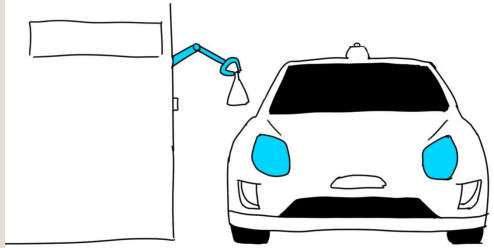


09

The car detours for a cup of coffee...!!

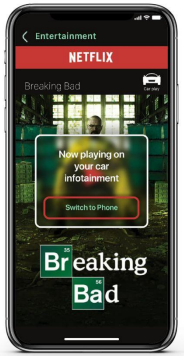
10

Gets that cup of coffee...



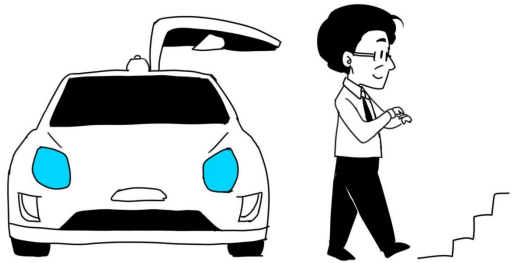
11

Drinks coffee while watching vintage TV drama Breaking Bad !!



12

Arrives at destination... The car looks for parking !!



13

Gets the notification that the car is parked.

LEARNINGS FROM USER FEEDBACK:

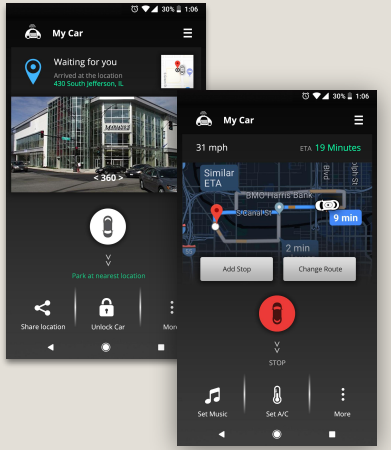
+ Trusting the car to drive in autonomy is a hurdle.

+ **Even when the trust factor will be up, users will want more control over their car's driving as long as it remains personal.**

+ Navigation and Services can be sorted by some hierarchy.

UX/UI DESIGN REFINEMENTS

ADDED FEATURES OF THE APPLICATION BASED ON USER FEEDBACK



Enhanced Navigation Features:
The application's navigation functionalities were refined to include more intuitive and detailed controls, allowing for better route customization and real-time adjustments, enhancing the user's sense of control over the vehicle.

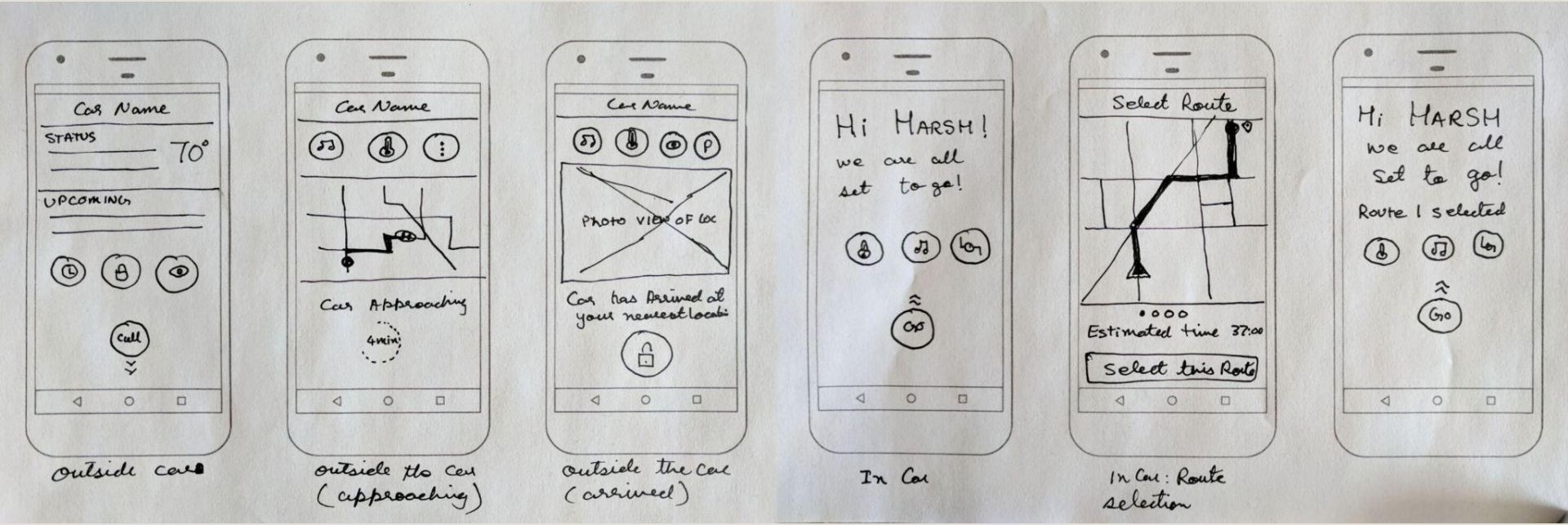
Improved Multimodal Feedback:
The interaction between the vehicle and the user was improved to include more clear and responsive feedback across different modalities, such as touch, voice, and visual cues. This refinement aimed to make interactions more natural and reassuring.

Security Enhancements:
Features related to vehicle security, such as digital locking and unlocking, received additional layers of security measures to ensure user data privacy and prevent unauthorized access.

User Interface (UI) Improvements:
Based on feedback about the usability of the application, the UI was updated to be more user-friendly, with clearer layouts, easier navigation, and better integration of features like vehicle monitoring and media control.

Connection and Integration:
Enhancements were made to allow for smoother integration with other devices and platforms, ensuring that users could seamlessly connect their vehicle with mobile phones, watches, and other personal devices.

FINAL DESIGNS



[Wireframes for the refined design]

Based on feedback from our initial application, we refined the navigation features of our autonomous vehicle application to enhance future connectivity and functionality.

FINAL DESIGNS

I designed the new application for the Android platform and followed the Google's Material Design guidelines for the same.

CURRENT STATUS

Shows the current location and status of the vehicle: Parked, Arriving, Picking etc.

UPCOMING

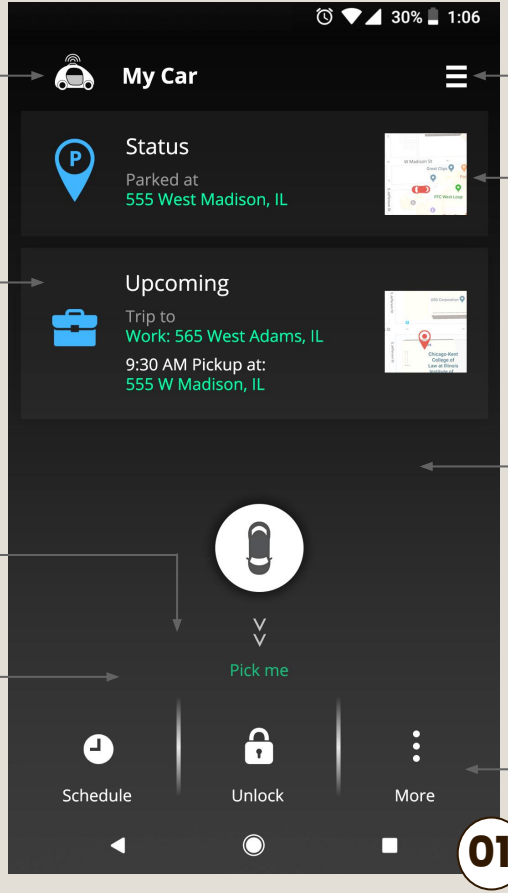
This tab displays the data about any upcoming trips if any.

LOCK/UNLOCK

The vehicle remotely/from a distance.

SCHEDULE

This button takes the user to the 'Schedule' section where one can schedule trips for the future in advance or cancel any trips already scheduled



MAP VIEW

Status: For locating the vehicle in real time.

Upcoming: For viewing/editing the destination for the upcoming trip on the map.

SWIPE FOR ACTION:

For actions that involve actual movement of the vehicle. This helps in the case of accidental touches.

+

HAPTIC FEEDBACK:

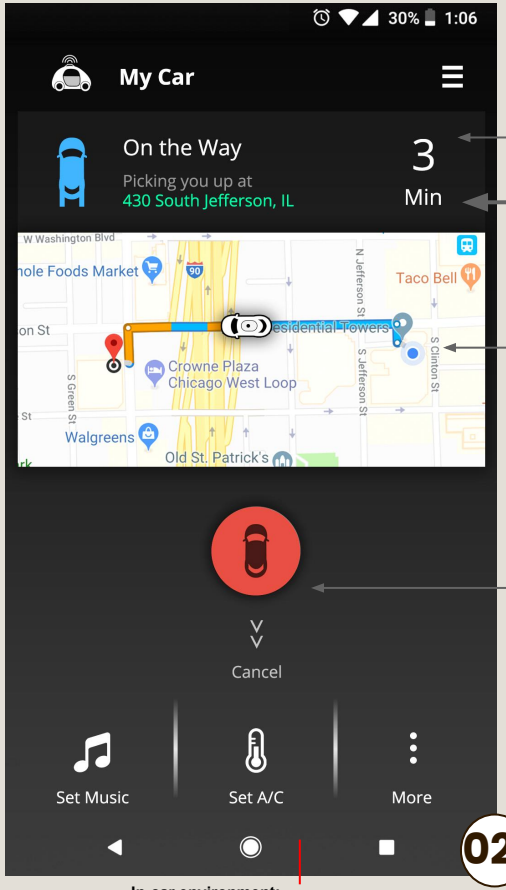
The device vibrates to confirm the commands which involve actual vehicle movement.

MORE:

All the services are nested under the 'More' section to cut down the clutter on the main screen.

FINAL DESIGNS

DASHBOARD: IDLE



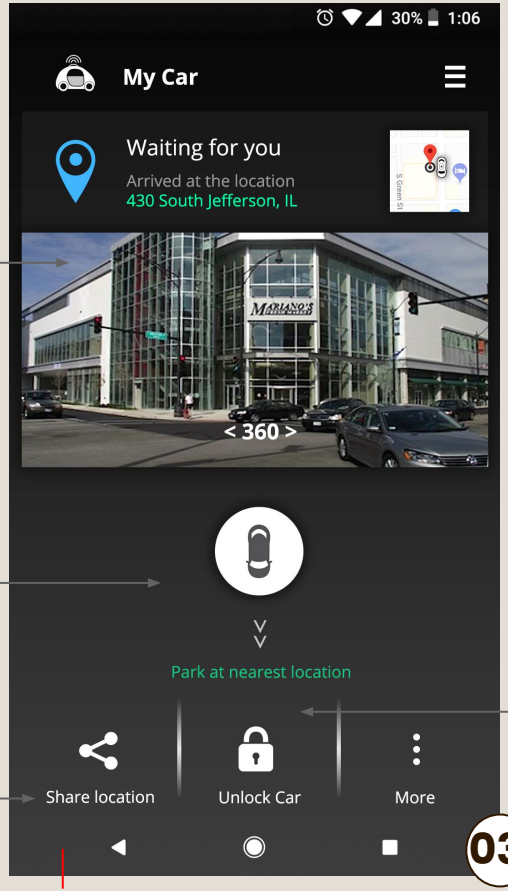
ESTIMATED TIME OF ARRIVAL

MAP VIEW

Cancel Pickup

In-car environment:
Once the vehicle is on its way to pick up the user, they get the controls like temperature and music.

ON THE WAY TO PICK UP → **CAR ARRIVED**



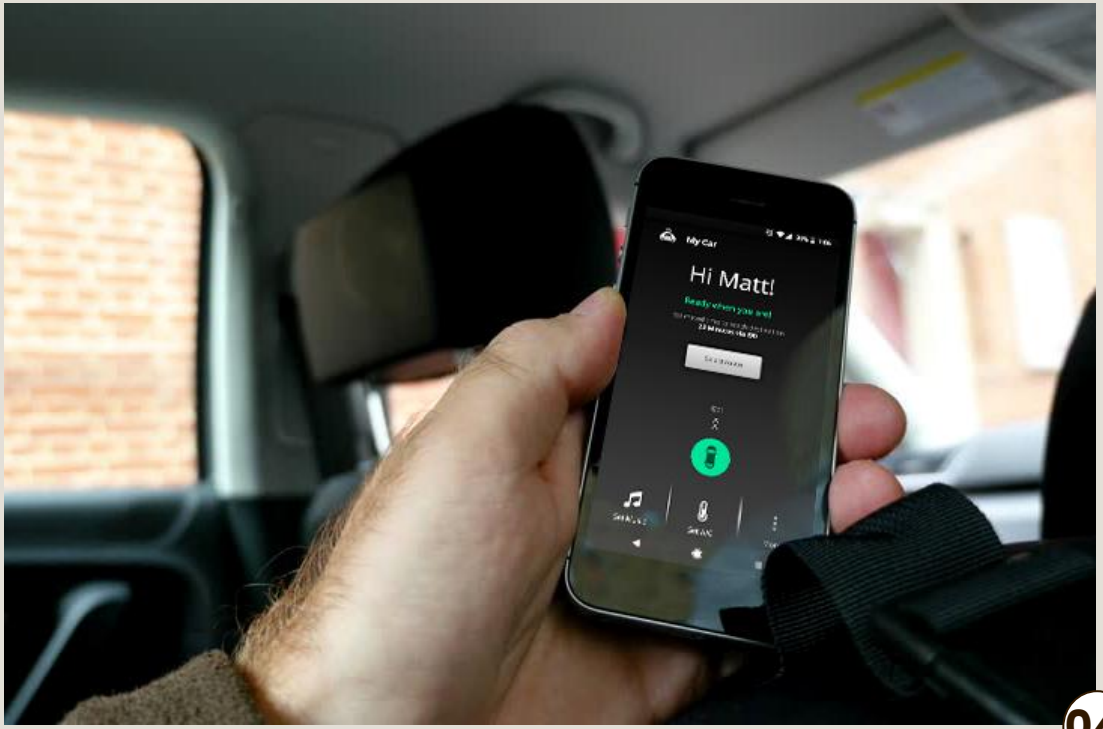
Once the vehicle is at the pickup location, it updated the user with a 360-degree image of its current surrounding.

Park the vehicle at the nearest available parking location in case the user doesn't want to ride immediately.

Share location of the vehicle with your family and friends

Once the car is at pick up location, the user gets the control to unlock it.

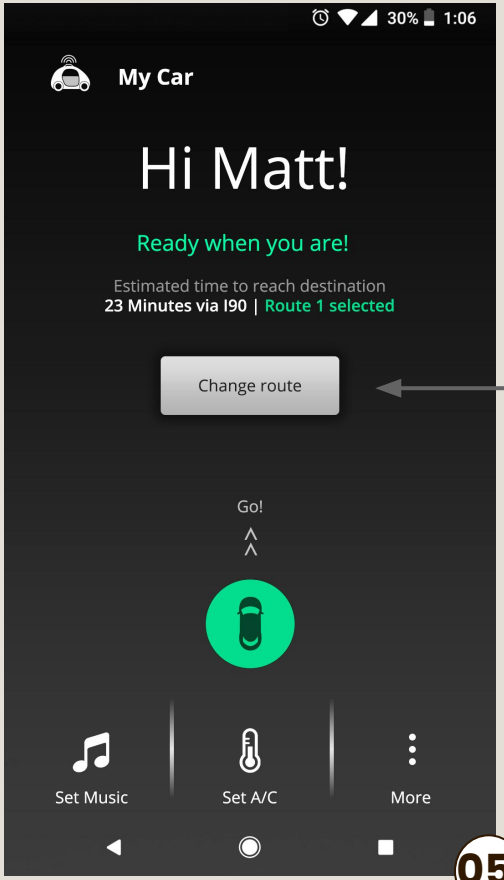
FINAL DESIGNS



04

Context Detection: When the user enters the vehicle, the application screen changes, greeting the user and giving more options for navigation.

FINAL DESIGNS

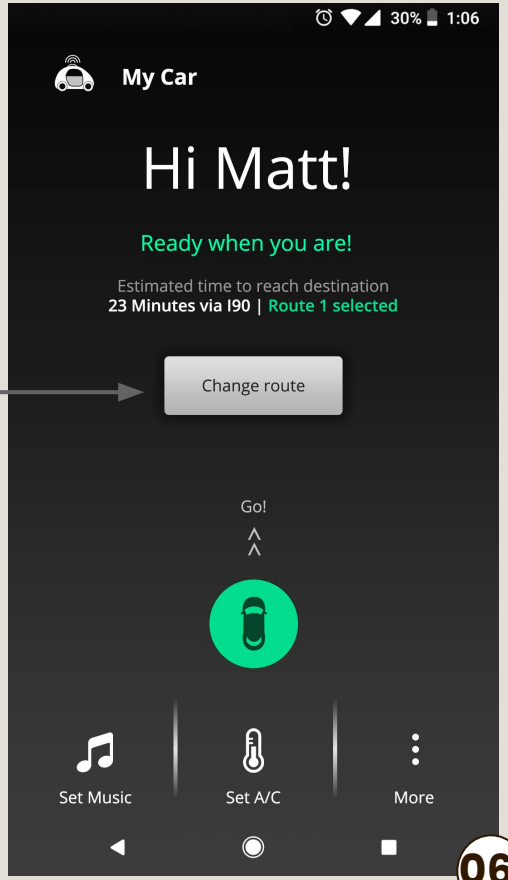


05

ROUTE SELECTION SCREEN

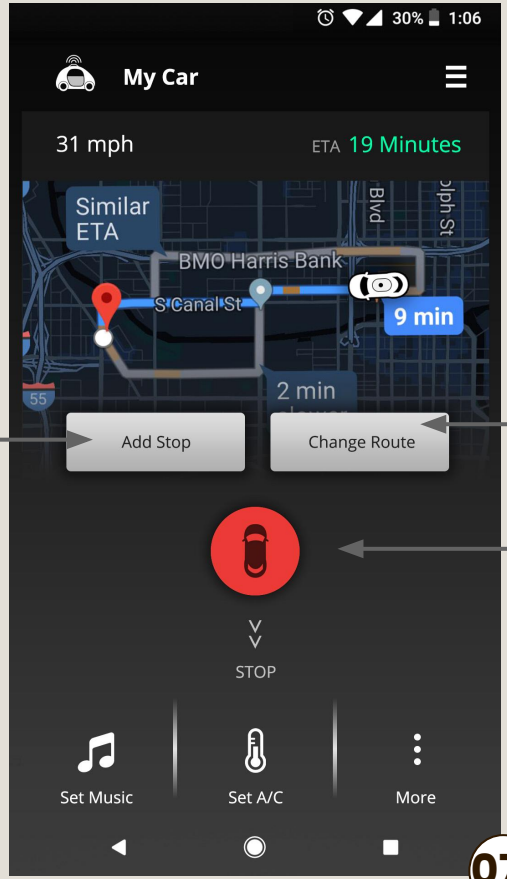
User can select their route according to their preference.

WHEN USER ENTERS THE VEHICLE



06

FINAL DESIGNS



07

DASHBOARD: TRIP STARTED

Add stop to your current trip

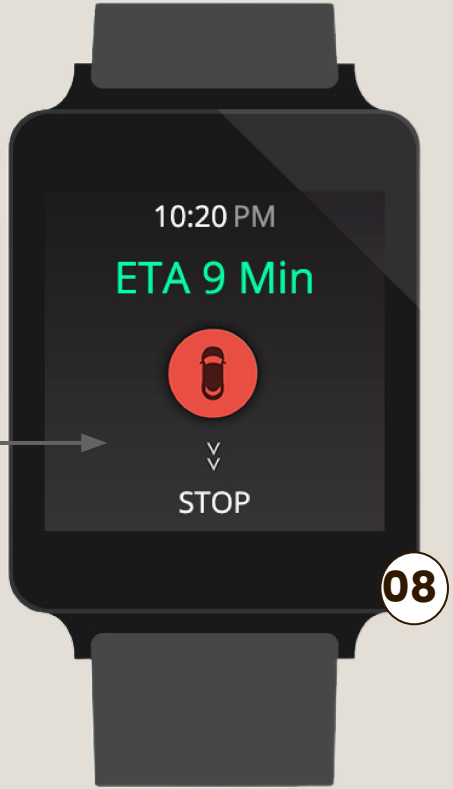
Add stop to your current trip

Swipe to stop

Also available on your android watch-face when on trip.

User can stop the vehicle using this feature in the middle of a trip. Vehicle will slow down and find a safe stop.

The idea is to provide them with a control similar to the break paddle.



08

“BREAK PADDLE” WATCH-FACE, ACTIVE DURING A TRIP

PROJECT REFLECTIONS:

These project reflections address the key factors that will determine the success and scalability of autonomous vehicles in the market, ensuring that the technology not only meets technical expectations but also aligns well with user needs and societal norms.

Trust is Central: Building trust remains at the core of user adoption. Future developments must continue to focus on enhancing transparency and control for users to foster this trust.

User Empowerment: While automation is a key feature, empowering users with control options and customization enhances acceptance. Ensuring that users feel they are in command, even in an autonomous setting, will be crucial.

Privacy and Security: As technology advances, so do concerns about data privacy and security. It is imperative to integrate robust security measures and transparent data policies to address these concerns effectively.

Comprehensive Testing: Ongoing testing in real-world scenarios is necessary to gather data on user behavior and system performance, ensuring that the system is responsive and reliable under various conditions.

Regulatory and Infrastructure Readiness: Coordination with regulatory bodies and alignment with infrastructure developments will be necessary to ensure that the service can be reliably deployed at scale.

Thank You