Car Safety System
Final Slides
Group 16

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Introduction

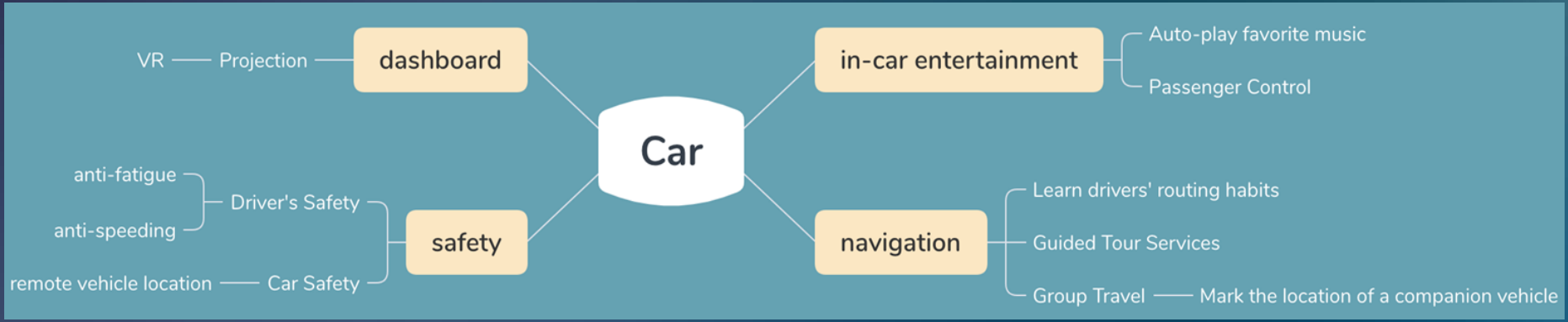
Our product is **Car Safety System**, a system dedicated to improving car safety. It is composed of 3 main parts: the safety devices, the central control system and the supporting mobile app, which can ensure both the safety of the driver——anti-fatigue, anti-speeding, etc., and the safety of the car ——remote vehicle location, real-time vehicle monitoring, etc.

This presentation will explain the purpose and function of the system and introduce its development process in detail according to the UCD lifestyle.

Idea Generation

Our development journey begins with the topic selection. Choose one from 4 areas as our project theme. We used brainstorming to generate different ideas about these 4 areas.

We finally felt that safety-related ideas were the most interesting and challenging, so we decided to make it our project topic.



Empathize

Our problem is defined as "improve the safety of the car, including the safety of the driver and the safety of the car” .

After defining the problem, we need to understand users and identify their needs, so we need to collect data. We used a combination of online questionnaire and semi-questionnaire structured interview.

Firstly, we used online questionnaire to collect data from a large number of users, and then used interview to explore the underlying causes of certain problems.

Questionnaire

- learning existing car safety technology
- observing car drivers driving
- thinking about our own driving experiences

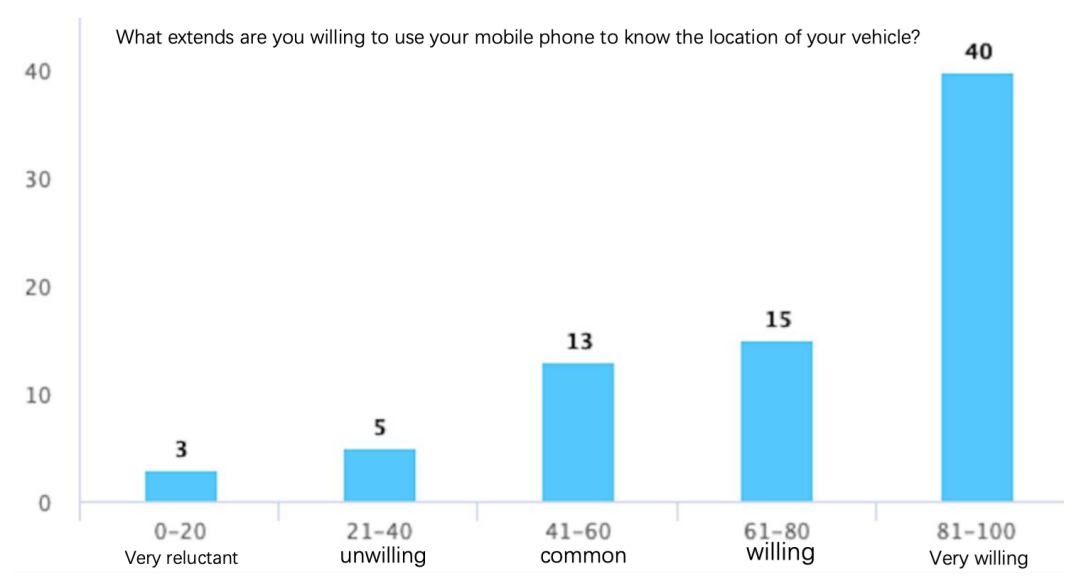
- small-scale
- asking family and friends to fill out the questionnaire

Sometimes, users may not be aware of their needs. Therefore, we designed questions in many ways. Before distributing the questionnaires, we carried out a small-scale pilot, and based on feedback we modified questionnaire and posted it online.

Questionnaire

Some particular questions provided noteworthy results that were useful when developing our prototypes.

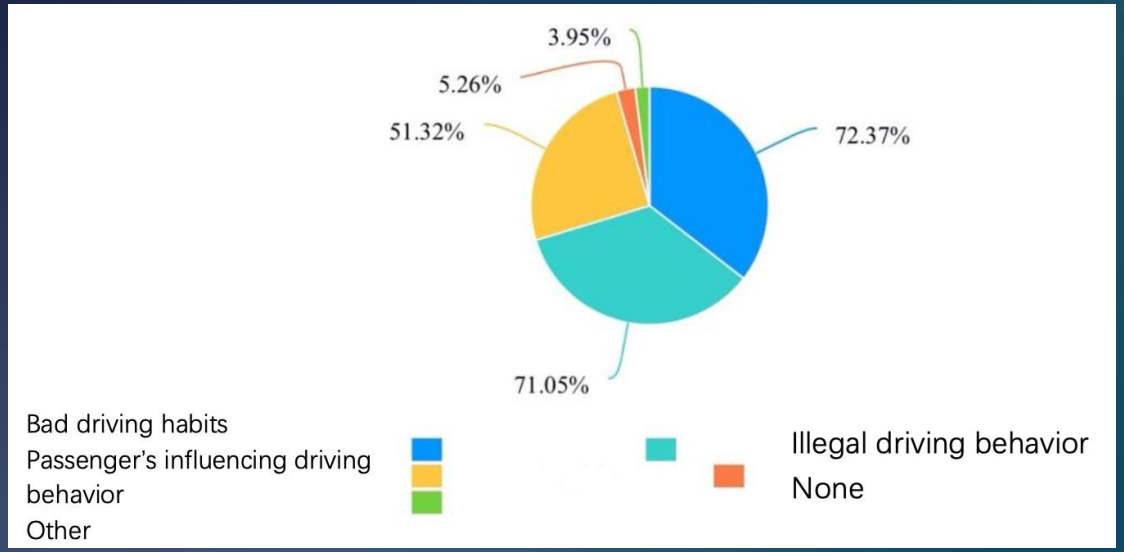
What extends are you willing to use your mobile phone to know the location of your vehicle?



The majority of people are very willing to use their mobile phone to check the location of their cars. This is also the feature we wanted to provide from the beginning, and the answer to this question proves the necessity of this function.

Questionnaire

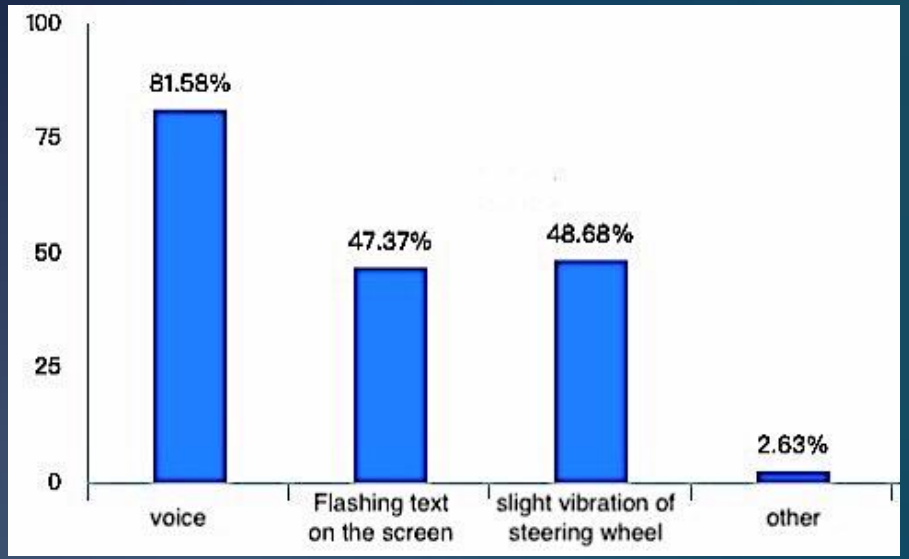
What behaviors do you think the in-car safety system needs to monitor?



From this problem we get the conclusion that Users would prefer an in-car safety system that could monitor both bad driving habits and illegal driving behavior. Therefore, we decide to implement both functions.

Questionnaire

What waring method do you think is more effective?



Users prefer voice as a warning alert, so our prototype should use voice as the primary warning alert.

Questionnaire

There is an open question in the questionnaire: What do you think a car's safety system should be able to do?

The answers to the it revealed issues that we hadn't thought of before. For example, many users mentioned that they would like the car to brake automatically to avoid danger, and that they would like to have a full-time, full-angle camera in the car.

So, in subsequent interviews, we will focus on the answers to the open questions and explore their underlying reasons.

Semi-structured interview

We interviewed each of our family members and friends (6 people) who can drive, because COVID-19, we conducted the interview by phone. We told them before the interview that we would record the conversation and asked for their permission to start the interview.

We used semi-structured interview: interviewer first asked interviewee some pre-planned questions. When there were answers that interviewer was interested in, interviewer deviated from pre-planned question, and then encouraged interviewee to say more, and discussed with interviewee to get as much information as possible. Interviewer played the role of a student throughout the process and interviewee was 'mentor', which made interviewee feel that her/his opinions are important to us.

Semi-structured interview

Some selections of interview that were useful when developing our prototypes.

Interviewer: What do you think a car's safety system should be able to do? Speeding alert? Fatigued driving alert?
Interviewee: These are all good features. But I think of a very important one. I had an accident once because I was initially blocked by a large truck in front of me and when I changed lanes I hit the car in front of me because I was driving too fast. If my car can detect the distance to the vehicle or obstacle in front of me and determine if I need to brake I wouldn't have been involved in an accident.
Interviewer: Do you want your car to brake automatically or in some other way to tell you that you need to brake?
Interviewee: If I'm too close to the vehicle in front of me, I want it to brake automatically; if it's not too close, I want my car to remind me to brake by voice.

Semi-structured interview

Interviewer: Would you want to know the location of your car from your mobile phone?
Interviewee: Of course.
Interviewer: Why?
Interviewee: Because I want to know where I've parked my car and I often can't find it in the car park.

Interviewer: Would like to have a full-time, full-angle camera in the car to monitor your car?
Interviewee: What do you mean?
Interviewer: For example, if someone breaks or hits my car when I'm not in it, I can know from the camera. The camera will then automatically send a video to my phone.
Interviewee: Sounds good, I would like to have one in my car.
Interviewer: Why?
Interviewee: Because my car isn't cheap, and I'd be dying to know who hits my car!

Semi-structured interview

At the end of the interview, we summarized all the answers to the questions and asked interviewees if the summary clearly expressed their responses.

There was a lot of qualitative data in the interviews, and we observed and discussed together.

We synthesized these data from different perspectives, identified key themes, and derived some requirements, and each requirement has corresponding examples to illustrate.

Personas

Personas is a method to make virtual characters which used to represent a part of the target population. Integrating the information collected through the questionnaire into a character can help us understand user needs more clearly.

In our group design, we conducted a comprehensive analysis of the driver’s age and some safety-related behaviors by studying the results of the questionnaire. Then three personas were created.

Personas

The first type of people are mainly novices who have not been in contact with cars for a long time. Through the results of the questionnaire, we conclude some characteristics of this kind of people and fabricate a false character model to represent this kind of people. And give him a name and a picture to make this character more vivid.

Tomas - "Novice"

"I'm not good at driving on complicated roads."

Thomas is a very inexperienced driver who has been licensed for less than five years. He needs a system to monitor what's going on around the vehicle while he's driving.
He hopes the safety system will help him reduce accidents so that he can protect his car.
In addition, he likes to use his mobile phone to control some conditions on the car, such as checking the fuel consumption and mileage.

Behaviors

Days of driving per week

1 — 7

Spend on safety systems of the car

Basic — Expensive

Real time vehicle positioning

Unwilling — Willing

Traffic accidents in the past three years

low — high

Monitoring behavior in the car

unwilling — willing

Key Characteristics

·Age: 20-30
·Driving experience: 0 - 5 years
·Rarely drive
·Willing to spend some money on safety systems.
·Like to use mobile app to do something.
·Hard to drive in some complicated places.
·Difficult to grasp the situation around the vehicle.

Goals

·Detect the driving environment around the car.
·Connect mobile phones to cars
·It would be better if the vehicle has a hazard prediction system.
·A reversing system is necessary.

Personas

The second group of people concluded from the results of the questionnaire is those who have 5-10 years' driving experience. They have a certain dependence on the vehicle safety system and are willing to upgrade it.

Crystal - ”Safe drivers”

"The safe driving system gives me a sense of security."

Crystal doesn't drive very often unless she has social needs. She would like to have a system to regulate her driving so that she can socialize safely. She thinks it's necessary to have some voice cues when driving.

She is willing to spend money on driving safety systems to help her reduce the number of dangerous driving.

Moreover, she hopes to be able to check her driving situation through her mobile phone and remind her of the most frequent dangerous driving recently behaviors before driving each time.

Behaviors

Days of driving per week

1 — 7

Spend on safety systems of the car

Basic — Expensive

Real time vehicle positioning

Unwilling — Willing

Traffic accidents in the past three years

low — high

Monitoring behavior in the car

unwilling — willing

Key Characteristics

·Age: 30-40
·Driving experience: 5 - 10 years
·Prefer to be a safe driver.
·Need security assistance.
·Not satisfied with the existing driving safety system, hope to have more functions.
·Willing to pay to install security systems.
·May be careless when driving.

Goals

·Monitor driver status.
·Detect the driving environment around the car.
·Check the information of dangerous driving of herself through mobile app.

Personas

The third group is classified as experienced drivers. They think safety systems are necessary, but they don't want to be too restrictive. They are more interested in monitoring the vehicle through mobile phones and replaying surveillance video when necessary.

Tom - ”Experienced drivers”

"In fact, I've rarely had safety problems while driving."

Tom often needs to drive to and from work. He has been driving for more than ten years. The safety of the vehicle is something he often needs to consider. Although he is very skilled in driving, what he usually worried is that the car will have some problem when he leave far from his car.
He is willing to pay for the safety system of the vehicle, but not all the monitoring methods he will like.
He thinks it's very interesting to use mobile app to control vehicles, but he hopes mobile app is convenient and easy to use.

Behaviors

Days of driving per week

1 — 7

Spend on safety systems of the car

Basic — Expensive

Real time vehicle positioning

Unwilling — Willing

Traffic accidents in the past three years

low — high

Monitoring behavior in the car

unwilling — willing

Key Characteristics

·Age: 40-50
·Driving experience: More than 10 years
·There are few accidents when driving.
· He is confident in his driving skills, so he rarely turns on driving safety mode.
· Would consider spending money on car security and surveillance systems.
·Doesn’ t want to install a safety system to monitor behavior in the car.
·Willing to monitor the location of the vehicle.

Goals

·Check the safety condition of the vehicle at any time.
·Don't want to get frequent safety tips when driving.
·The function of mobile app is simple and easy to use.

Personas - Evaluation

As far as our group design is concerned, we have realized the following advantages of using personas. First of all, it is very useful to use vivid characters to represent complex and boring data information collected from questionnaire.

Secondly, observing the personas created can make us pay more attention to the general characteristics.

Last but not least, the use of personas can ensure that we always focus on the user in the discussion process, and will not completely follow the subjective ideas of our designers.

Scenarios - Evaluation

When several characters with characteristics and goals are created, bringing them into a specific scenarios helps we designers deepen our understanding of some details and contents about the design.

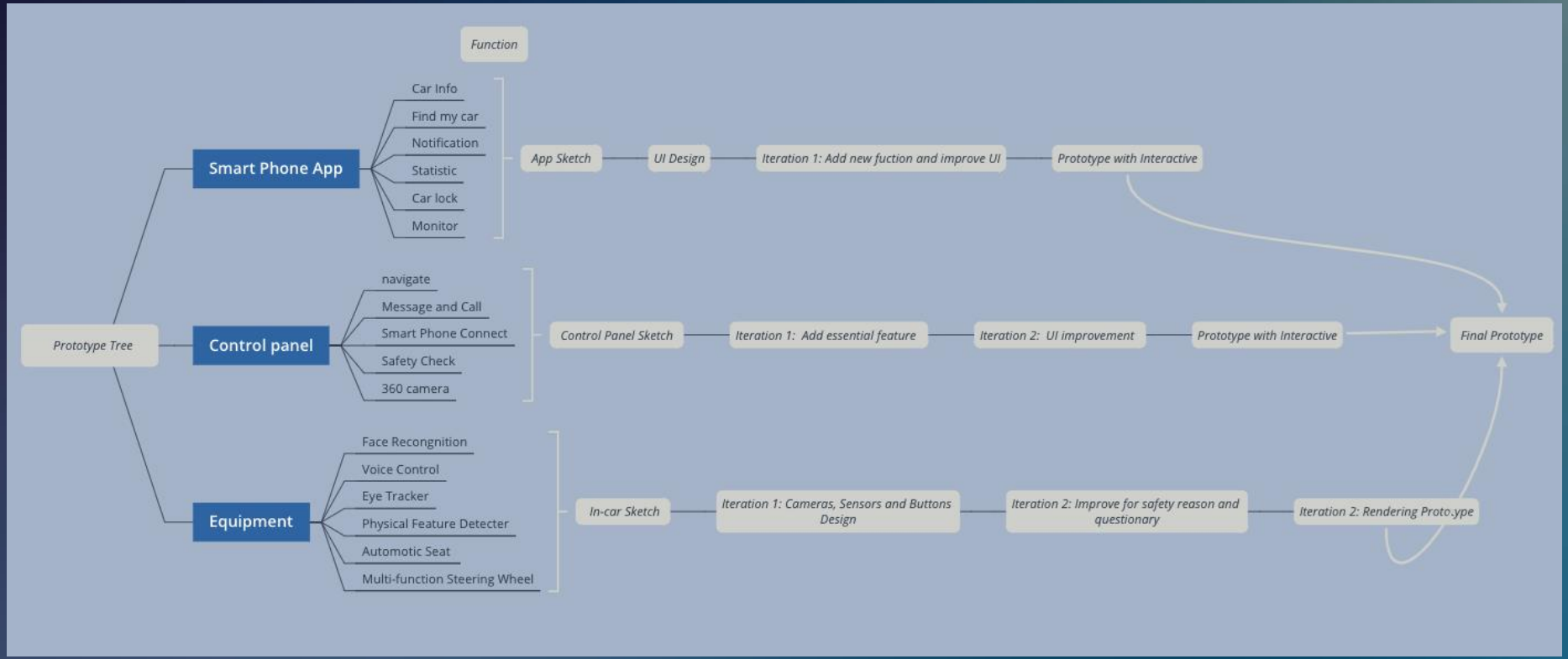
In addition, by taking the characters into the scene, we can learn a lot of design details, including some possible limitations and opportunities.

Existing solutions

We looked at some existing solutions on how to associate mobile phones with cars, and most of the solutions are to use Bluetooth.

In addition, 360-degree panoramic cameras have been used in some cars. Using this system and improving it can solve the parking problem in our design and the problem of monitoring vehicles.

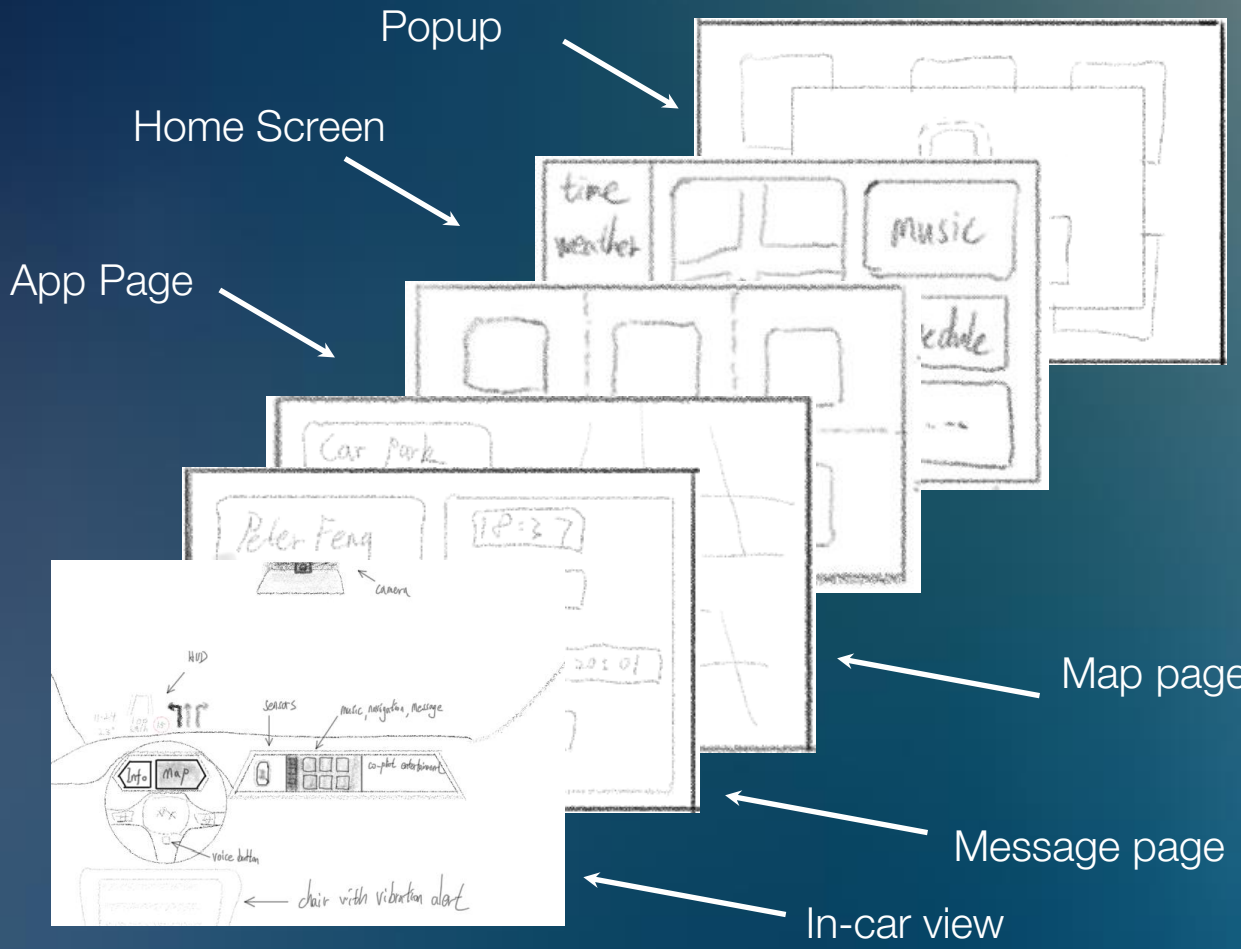
Prototype tree



Sketch

At the beginning of the design, we planned to replace all physical buttons with screens. For the safety of users in driving, our meeting did not have too many elements, but turned some complex operations into voice.

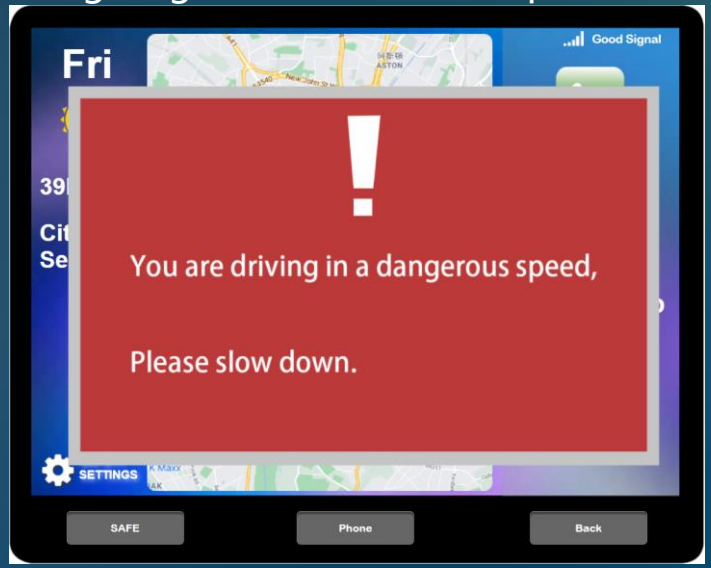
Some respondents reported that they couldn't control the touch screen accurately while driving. So we reduce the app interface icon. In the information, the app uses voice input and voice reading. In the main screen interface, we use different modules to display information.



Prototype of Central Console

1. Iteration

There are truly some iterations in our center console prototype, but most of them are based on aesthetic and operation.
One of the most significant iterations of the center console is that we deleted warning images of speeding and rear-end in the previous version, which can be send by sounds. This iteration will make the whole system more robust, without giving users too much repeated informations.
The reason is that not only from the results of our questionnaire but also from the feedbacks of user prototype evaluating(After the user test our system, they find out that the warning image will cover the navigation page, influence their driving), we concluded that users prefer a acoustic warning to a visual one, which are considered as a kind of interference when watching navigation.



Prototype of Central Console

1. Iteration

Another example of the most significant iterations of the center console is that we modify the layout of the call interface, by moving the dial pad to the bottom. It’ s because most users who took a test told us it’ s uncomfortable if there is a space at the bottom of the screen.

Prototype of Central Console

2. Abstract Introduction

Basically, our prototype can be defined as four phases.
We want to maximize the functionality of the entire security system through phase separation.

Every phases contains many important safety functions and logics.
This division avoids having too many safety functions in one layer, in which case it’ s more difficult for users to recognize and operate.

Prototype of Central Console

3. Tools and Advantages

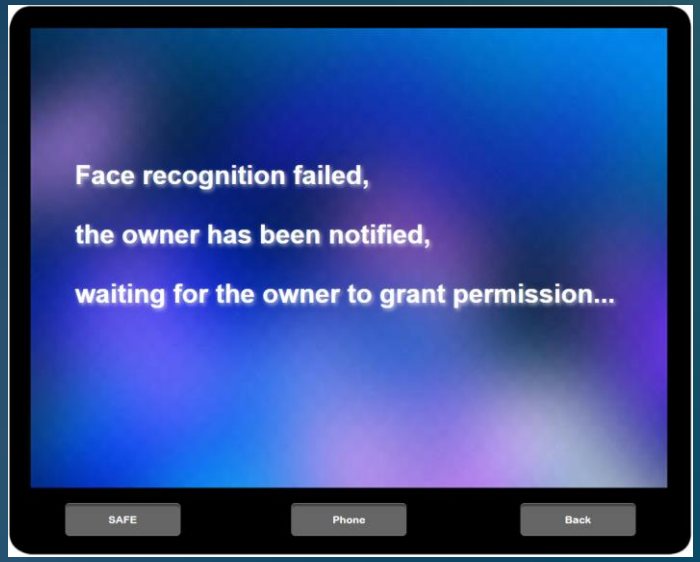
We mainly use Axure and Photoshop as tools to build a prototype, they are time-saving for us to turn our conceptual design into a physical one.

We can easily publish it on the internet with an IP address, so that users who are involved in the evaluating process don’ t have to face to any local files or images, and have a easy way to operate and give feedbacks.

Prototype of Central Console

4. Prototype Display - the 1st phase - Face Recognition

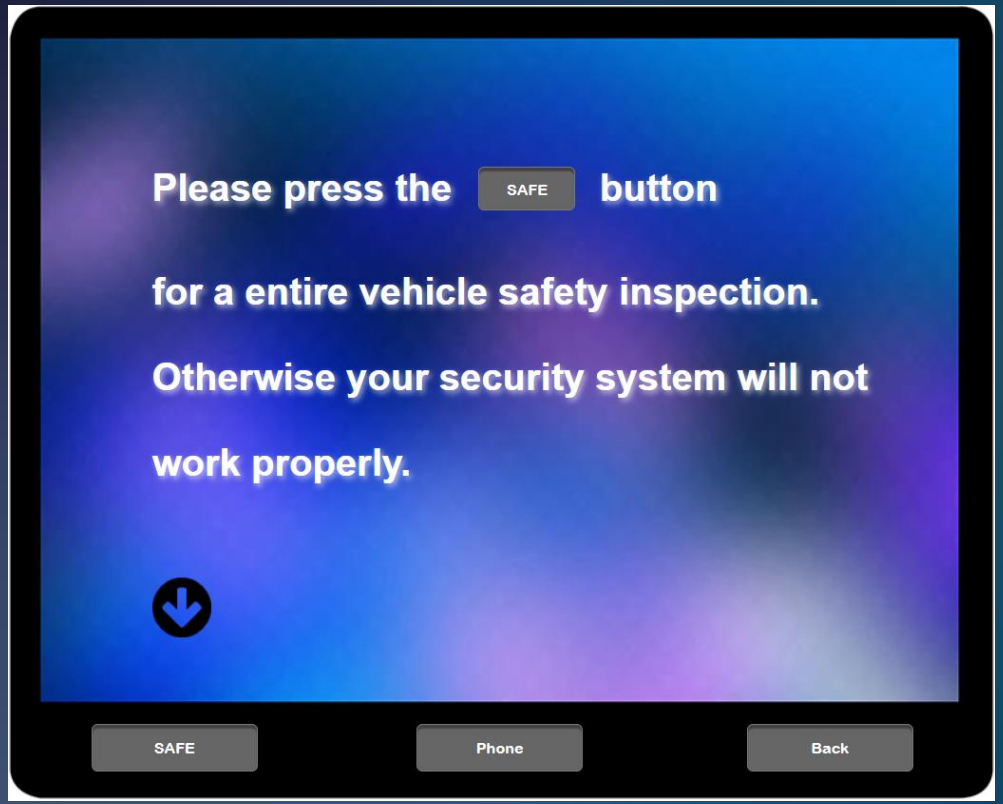
As mentioned before, we can display the prototype as four phases.
Let’ s begin with the first phase —— face recognition.



To confirm it’ s the owner who is on the driver seat, there will compulsorily be a face recognition when you enter the car.
Normally the interface will tell you to continue, as the left image shows.
But if it’ s not the owner on the driver seat, the system will notify the owner remotely, as the right image shows.

Prototype of Central Console

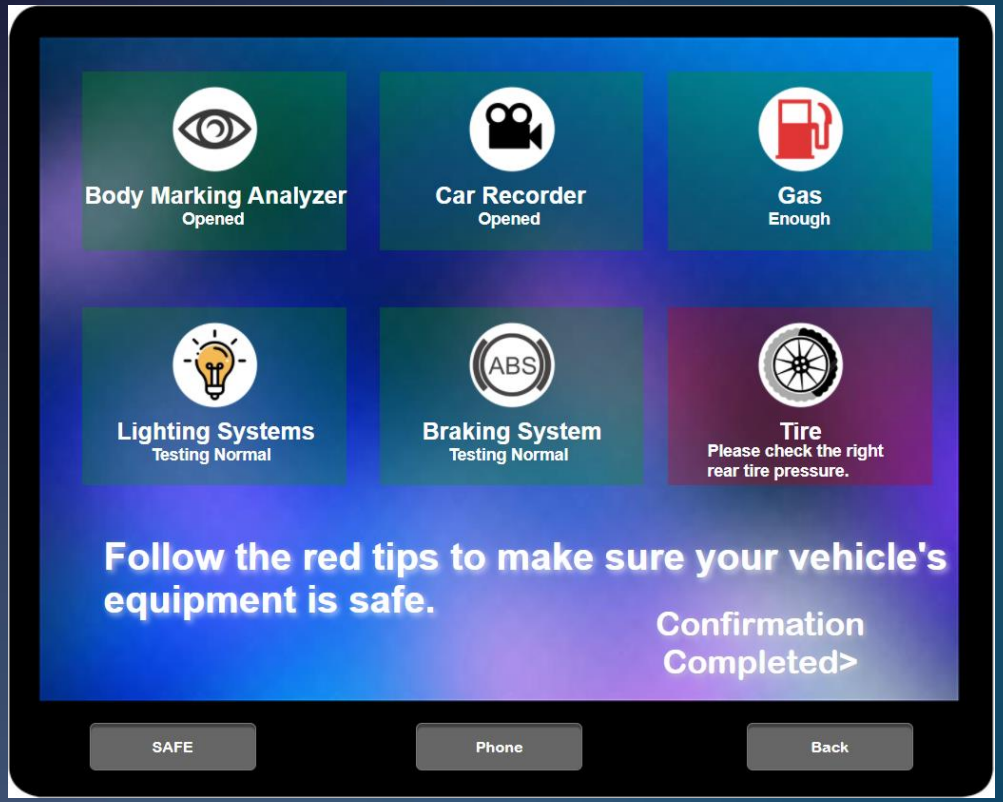
4. Prototype Display - the 1st phase - Face Recognition



Next, the interface lead you to press the SAFE button to go for the Vehicle Inspection

Prototype of Central Console

4. Prototype Display - the 2nd phase - Vehicle Inspection



Here it shows a dashboard of every module related to car safety.

The normal module will be with a green background. Drivers should follow the red modules to check and correct their devices.

When you has finished the check, you can press the text on bottom right to the main interface.

Prototype of Central Console

4. Prototype Display - the 3rd phase

The 3rd phase are divided into 2 branches. One is for some normal functions, the other is for the settings of safety functions.

We divided these two branches because it’ s convenient to change some functions you think are unnecessary in some certain situations when you are driving and are assumed to face to the normal functions.

Prototype of Central Console

4. Prototype Display - the 3rd phase - Main Interface

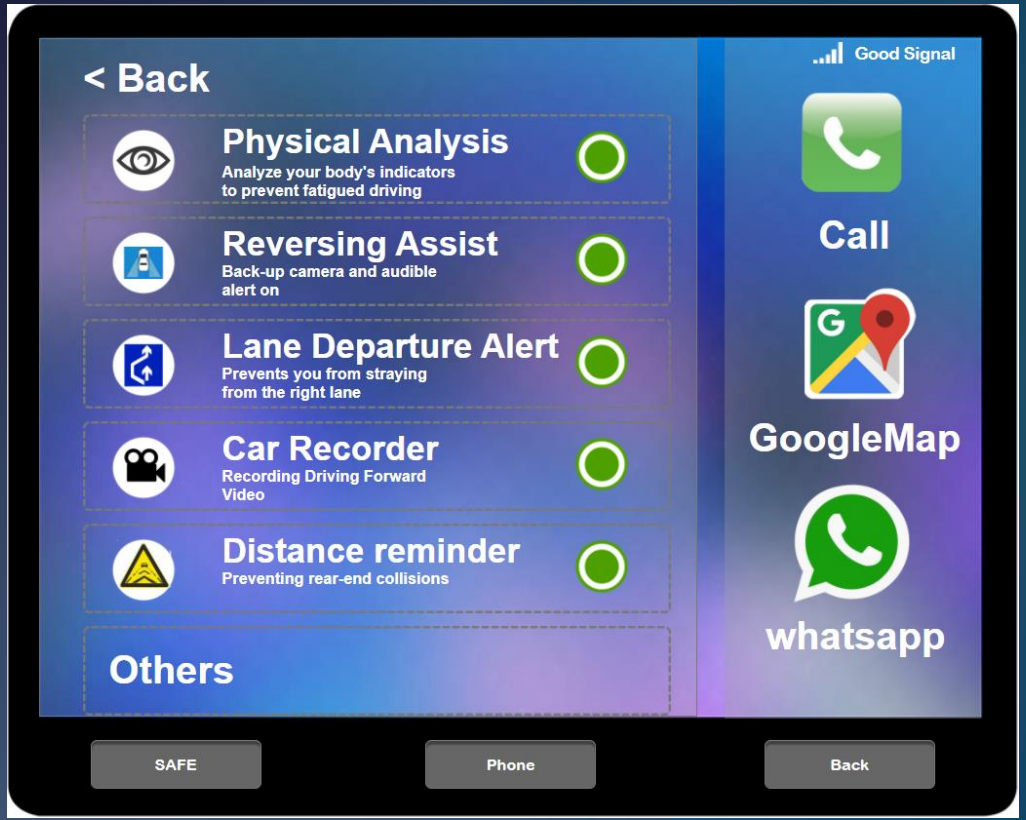
The main interface is about some normal uses.

As we can see, on the left, it shows the date, weather, speed, and road section.
In the middle, there is a big map so that you can get navigation.
On the right, there are apps from your phone which is permitted to use on the center console.

When you tap the text on the bottom left, it will lead you to safety settings.

Prototype of Central Console

4. Prototype Display - the 3rd phase - Safety Settings



The text button on the last interface lead you to this safety setting interface.

We can change 5 kinds of safety options here.

But keep all of them on is recommended, except that your driving situations are really not in line with the default options.

Prototype of Central Console

4. Prototype Display - the 4th phase - App Interface

Following the first branches (Main Interface) of the 3rd phases, we can enter the app interface of one on your phone.

Here we give an example of call app.

Prototype of Equipment in car

1. Equipment Iterations

iterations
The vibration function of the steering wheel was removed based on the feedback from the users' questionnaires. The user thinks that the vital signs will not be checked all the time by driver, but only need to be reminded when there is a problem. Moreover, the vital signs device occupies the location of the air conditioning port of the car, so they just let the steering wheel measure the user's vital signs The function of seat change is added, because the user experience feels that a slight change of seat is also a good way to focus people's mind

Prototype of of Equipment in car

2. Final prototype

face recognition

Facial recognition is applied to the car. Through the facial recognition function, the driver can be authenticated and different drivers' identities can be confirmed, and the car can be started, the seat position memory can be adjusted, and the car can be entered into the multimedia system. Facial recognition improves security, privacy and convenience. The functions that face recognition can perform vary from car to car.

Prototype of Equipment in car

2. Final prototype

eye tracker

Eye-tracking is joining the automotive world in a new way of human-computer interaction. By analyzing the track and stay of fixation points, attention monitoring can accurately judge the fatigue degree of drivers, instead of realizing the fatigue judgment through the length of closing eyes. Because under the condition of closed eyes, the driver has been a fatigue driving before, should not drive; In addition, by taking advantage of the physiological characteristics of human eyes, users can realize in vivo detection of face recognition and iris recognition without the cooperation of "opening mouth" or "winking eyes", so as to improve the anti-counterfeiting and ease of use of identity authentication.

Prototype of Equipment in car

2. Final prototype

physical feature detector

By setting the sign detector on the steering wheel body or the special steering wheel body cover, the body state information of the driver is collected. The collected biological signals will be processed to obtain real-time human signs and indicators, and to determine whether the driver has physical discomfort or sudden illness affecting driving.

Prototype of Equipment in car

2. Final prototype

physical feature detector

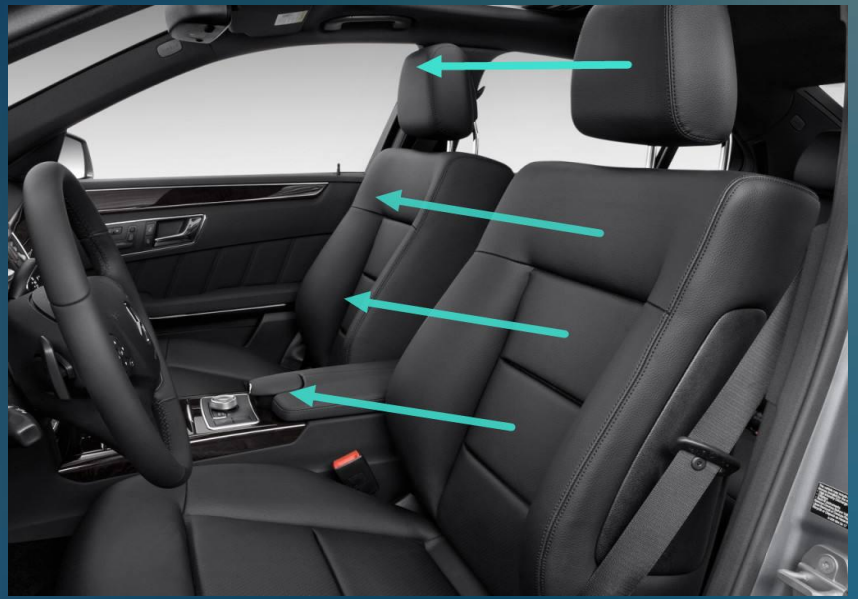
At the same time, the alarm device of the central control system is connected. If the human body sign detection system module judges that the driver has physical discomfort or sudden illness that affects driving, it will send an alarm. The utility model can accurately and real-time monitor the physical state of the driver under the premise of not affecting the driving operation, and can timely send out alarm and call for help information when physical discomfort or sudden illness occurs, so as to ensure driving safety and reduce the occurrence of traffic accidents.

Prototype of Equipment in car

2. Final prototype

automatic seat

On the basis of manual comfort adjustment, automatic adjustment function is added in the design of the seat. After the center control system obtains the driver's state through algorithm analysis, if the driver is judged to be tired or distracted driving, the signal will be transmitted to the seat control system. The seat focuses the driver's attention on driving by adjusting the Angle of the backrest and headrest. At the same time, due to the change of Angle, the fatigue degree of drivers can be correspondingly alleviated temporarily.



Prototype of Equipment in car

2. Final prototype

voice control

The voice input function will be set in the buttons on the steering wheel. In this way, people can do some relatively complicated things without having to divert their attention from the road ahead, such as finding a song on the player, setting navigation and other functions, and only need to solve it by voice. These operations will be as simple as pressing a button with your hand. And send instructions to the central control system. Then the central control system will make further processing and feedback.

Prototype of Equipment in car

2. Final prototype

Tachograph

By recording and playing back the surveillance video, the responsibility of the accident is clear and the traffic police deal with the accident quickly and accurately. It can not only evacuate the scene quickly and restore the traffic, but also retain the effective evidence at the time of the accident to create a safe and smooth traffic environment. If each car is equipped with a tachograph , the driver will not dare to drive illegally, and the accident rate will be greatly reduced. The vehicle causing the accident will be photographed by the dashcam of other vehicles, and the case of hit-and-run will be greatly reduced. At the same time, it can record what happens around the car at all times. When the car owner is outside the car and the car is damaged, the content of the recorder will be synchronized to the car owner's mobile phone.

Prototype of App

1. Iterations

In the car-info interface, the first version of the design is to display all the information on the page. However, in user test, many users felt that there were too many interface elements and the interface is too complex.

There are also statistics for users' dangerous behaviours in the application. Traffic violation, Bad behaviour and Trigger safety system were included in the first edition. Let users evaluate their driving behaviour. However, after the user simulations it was felt that because violations are deducted from your driving licence points, this results in a statistics graph that doesn't have a lot of data, making the statistics page that records the number of violations not very useful. So, in the second version of the prototype, we put the statistics on the number of violations into the user's personal information screen.

List all Info

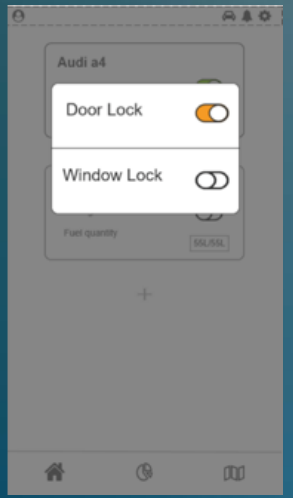
Prototype of App

2. Final Prototype-Home and user page

So in the second edition, we changed car-info interface to display the list of cars, leaving only some common information.After the improvement, if users need to view more information, they just need to click the big icon, so that users can get the key information more intuitively. Unnecessary elements are hidden.

In the Sideswipe menu, users can make privacy settings, such as face ID and whether to share car locations, and check the number of traffic violations.

The vehicle can detects that the door and window are not closed properly, it will send a push to the user, and the user can also enter the application to check the status of the vehicle's doors and windows. And it can be turned off by remote control.



Only show common Info

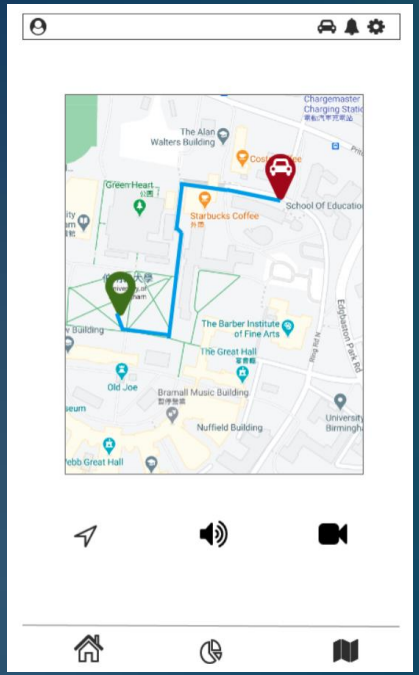
Prototype of App

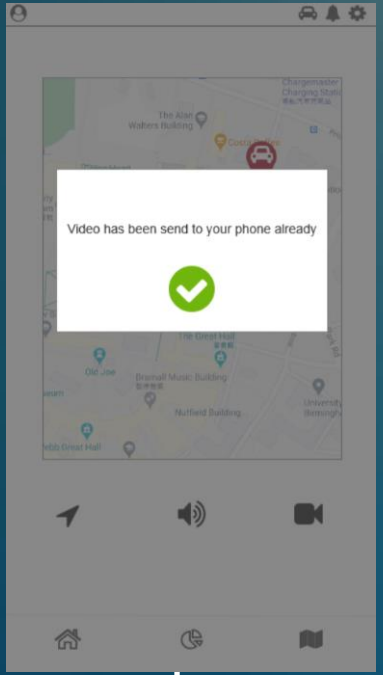
2. Final Prototype-Map page

In daily life, many users will forget the location of the vehicle after parking. To solve this problem, the car uploads the location to the server, and users can observe the location of the vehicle in real time. In the final version, we provided the user with the location information of the vehicle and pedestrian navigation in the "find my car" interface. When the vehicle is nearby, the user can press the volume play button to make the vehicle sound. This function help user find their car easily.

The vehicle also can transfer the video of the camera in car to user in real time by connecting to the cellular network. When the vehicle is detect uncommon condition, it will send message to user. Users can access the app to receive and view both in-car and surrounded real-time video. The video can become an important evidence when accident happen.

Added Navigation



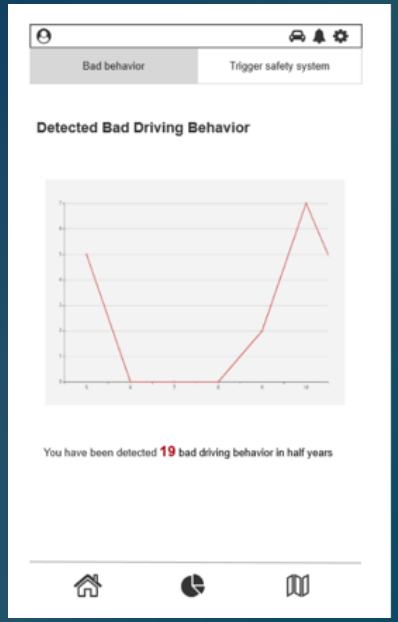


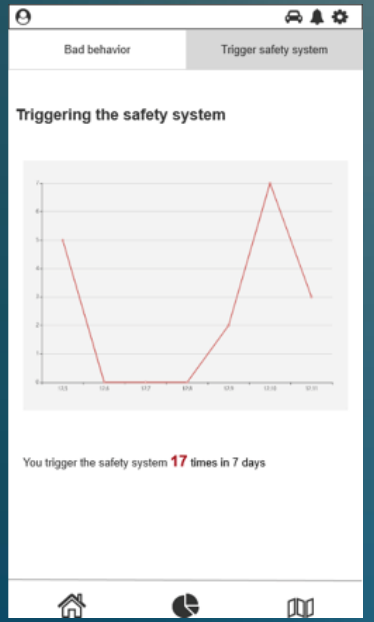
Added real-time video

Prototype of App

2. Final Prototype-Statistic page

In the second edition of statistic page, we optimised the chart to make the data clearer. And added text description. The traffic laws and regulations that are not commonly used are hidden in other interfaces.





More lear chart and text

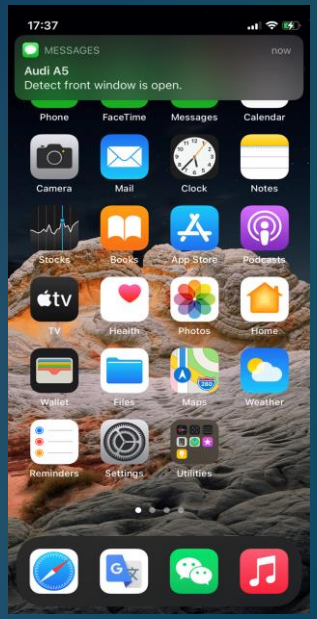
Prototype of App

2. Final Prototype-Guest mode

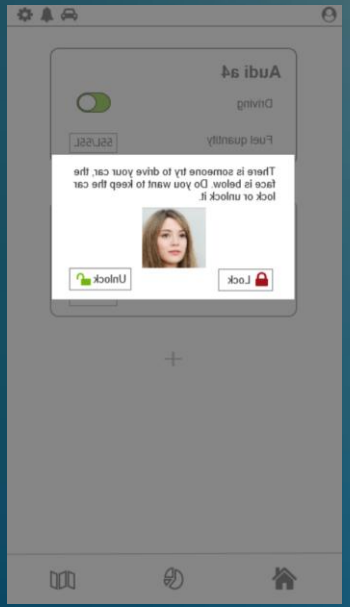
When other users enter the vehicle, they can not start the vehicle directly, but need the owner's approval, and the vehicle sends the photo of the current driver to the owner.

After entering the app, the owner can confirm whether to approve driving according to the pictures. This reduces the risk of theft.

User receive notification



Access App to approve



Project Summary

During the course of this project, we learned some valuable lessons about the design process:

- It is important to focus on the users early, to understand them and identify their needs in order to better define the design requirements. Questionnaires are really important, because if they are not well designed, you will get very little information.
- The importance of involving users early in the testing of the prototype. Early in the development process, users should actually use the prototype for evaluation, and developers should observe and record their use process and modify the product based on feedback.
- The importance of developing alternative designs. Multiple alternative designs keep us from focusing on one design too early.
- The importance of multiple iterations. When team members or users find a problem with the product, the team must immediately solve the problem, redesign the product, and prepare for the next test.

Project Reflection

If we were to do this project again, there are a few things we would do differently:

- We would have paid more attention to existing car safety technology before designing our questionnaire. While we did do some research, there were some questions in our questionnaire that were still not very useful to the design.
- We would have spent more time on the sketches so we may have gotten more useful designs.
- We would have asked more users for their opinions, most of our users are our friends and family and their feedback is similar, maybe we should expand our user range and get more feedback.

Teams and Division of work

During the whole design process, we met every week once or twice when every one finished own part. We have a share online document to note down which point needs modified and next week arrangement. In this way our program could push on and improved iteratively.

Collecting data, interviews and questionnaire is finished by Qinqing Huang and Jiacheng Xin.

Xin Wu, Yunliang Han and Haoze Feng are response to sketch and prototype.

Siahan Chen is leader of this program, scheduled our timetable, facilitated communication among members.