Human Computer Interaction and Design

COMP1649

FPT-GREENWICH UNIVERSITY

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Introduction

This report will provide the design of a new in car entertainment and navigation system based on the design tool Axure design. In addition, information related to dimensions of interaction design will be mentioned and used to assist in the design process of a new in car entertainment. Some user surveys and prototype designs will also be clearly defined. All will be presented completely clear, detailed and complete.

I – Background

According to (Edwards, 2015), the first navigation system was offered for use in 1985 by Etak company and it was called Etak Navigator. Etak Navigator was the first in-car navigation system and was later called the GPS system. Navigator is a system capable of positioning, navigation with high accuracy rate (Yunchun Yang, 2004). In 2000, Etak was acquired by Tele Atlas thereby opening up major development for navigation system and commercializing navigation system in car entertainment.

Nowadays, navigation system has been integrated as a feature in a car entertainment and all famous car manufacturers in the world have a car entertainment inside the car. A good car entertainment will help the driver will be able to conveniently and easily use all the technology found in the car, it provides all the entertainment information through audio, video, voice sensors, buttons and sensors on the entertainment screen. The development of technology also helps car entertainment to grow and there are a variety of entertainment and informational applications offered. In particular, the in-car entertainment system not only helps the car have a luxury but also helps users get comfortable in driving the car. Therefore, designing an in-car entertainment system will have to be optimally designed and easy to use.

II - Design concept and prototypes

1. Discussion of the five dimensions of interaction design

According to (Jonas Lowgren, 2004), interaction design is the design of interactions between people and a system or a device. Humans perform actions on a device, then receive feedback from the device and obtain the necessary information. Since the interoperability of people and devices is really difficult, the designs need to be simple and easy to understand so that users can use them

well. Here are five dimensions of interaction design that can make the design process clear and easy to understand.

Words

Words should be designed to be short and easy to understand and the information given should be completely accurate. In addition, the information given must have interaction with the user (Jonas Lowgren, 2004).

Visual representations

Elements include images, iconography and others, all of which represent interaction. Certain words are also used for clarity with iconography. In addition, there are iconography that can replace dimension words (Kamran Sedig, 2013).

Physical objects or space

The space around the user of the device affects the interoperability between the device and the user. The user's manual actions on the device directly or through an intermediary can also affect the interaction (Jonas Lowgren, 2004).

Time

This element can be understood as animated motions, video motions, and audio motions. Those elements create a clear user interaction, and it's the movements that change over time (Jonas Lowgren, 2004).

Behavior

This dimension is the user's actions on interface interactions and user feedback. It also includes all the actions and interactions of the previous four dimensions (Jonas Lowgren, 2004).

2. Discussion for each dimension and suitable visual representations

Words

For dimension - words, it is the message, the information for the user to understand easily. However, a message should not be used too long, especially the notice or information must be easy to understand and simply should not use specialized terms that are difficult to understand for users.
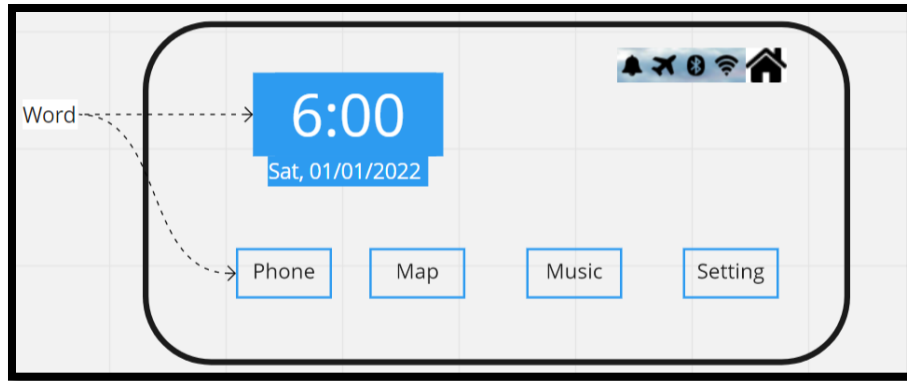
Figure 1. Dimension 1 - Words.

Visual representations

Simple images and icons can replace a complex message line. An example of an icon image will help users understand that the device is on ring mode. Even so, simple words with a button like Setting can also convey enough information to the user that this is a button to set status, time, and others.
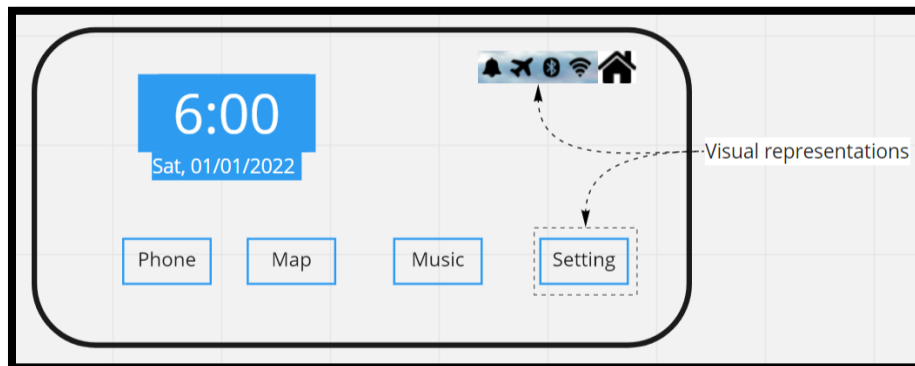
Figure 2. Dimension 2 - Visual representations.

Physical objects or space

Physical objects or space is the environment around the user interacting with the program. Therefore, the design must be based on the user's environment so that it is easy for users to manipulate and use. For example, the environment is the system in the in-car entertainment interface.
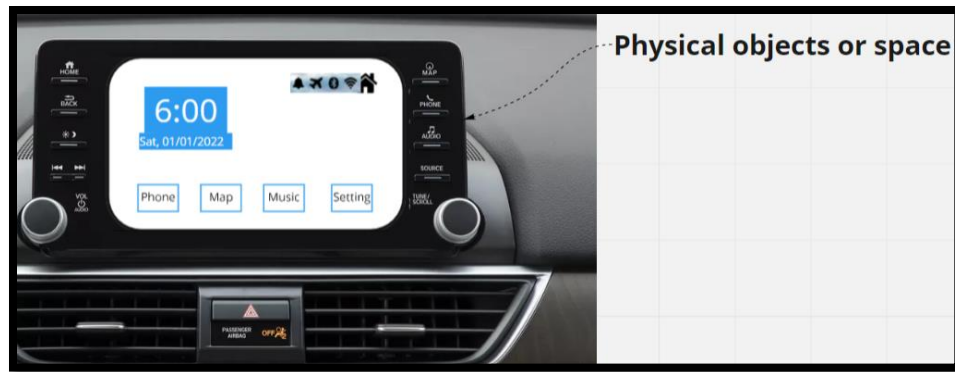
Figure 3. Dimension 3 - Physical objects or space.

Time

Time is an animation of interaction, video, and others. It will affect the ability to interact with active users. For example, when the user successfully turns on the Bluetooth connection, he will see the successful notification animation. That's pretty important for user interaction.
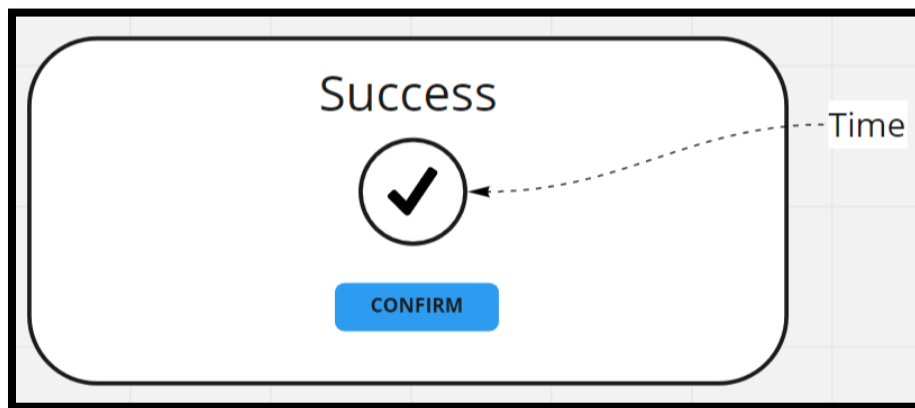
Figure 4. Dimension 4 - Time.

Behavior

A user action or response to the program will be positive if the notifications, notification animations are good for the user. For example, the successful notification action turns on Bluetooth and the user can press Confirm as a good response interaction.
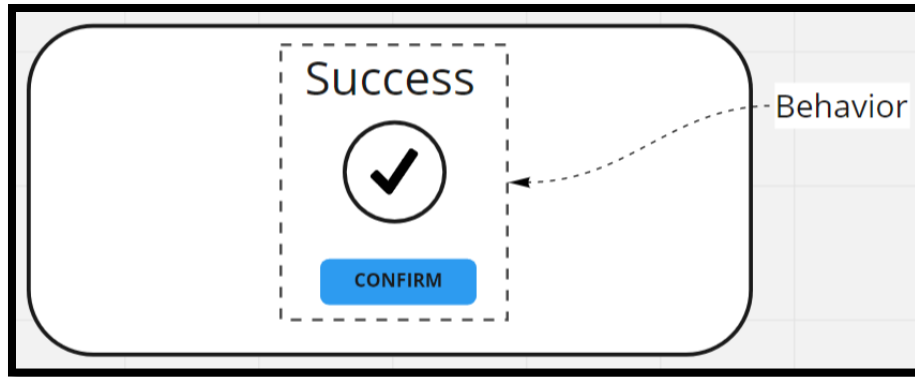
Figure 5. Dimension 5 - Behavior.

III - Cognitive Psychology

1. Interaction design theory

1.1. The hick's law

According to (Wanyu Liu, 2020), The descriptions of design principles claim that the response time of a choice affects the user's usage experience. To make the generalization easier to understand, the categories should be broken down to avoid users having a hard time understanding all of the content and choosing the correct one. Therefore, a message with too many options should not be given to the user.

1.2. The schema theory

According to (QH Mach, 2010), EEG imaging studies show that task perception can be divided into three distinct processes including segmentation, pattern recognition, and integration of patterns into a scene. Can understand schema describing a systematic pattern of thinking and behavior. Schema affects attention and absorption of new information. Therefore, the information should be broken down so that users can easily process the information.

2. Applying cognitive psychology

While designing low-fidelity prototype concept, I think applying hick's law and schema theory will make my design better for users.

2.1. The hick's law

Content will be specifically categorized and placed in pages with similar content. There, the subcategories will make up the big one, and the content won't appear duplicated on other pages.

2.2. The schema theory

For schema theory, categories put together in one large category represent the main content of all the subcategories. Users can manipulate from the large category, followed by the small category to search for results.

IV - Research Study

1. Method of research

According to (Taylor, 2006), research is an activity that attempts to answer an academic question or set of research questions about fact. Research carries out activities that include defining research problems, objectives, determining hypotheses and solutions, collecting data and evaluating, and finally drawing conclusions. According to (A Kumar, 2015), the research needs to use a set of research questions and methods. For this study, two methods of quantitative research and qualitative research will be used to prove and clarify the problem.

- Quantitative research

Quantitative research is the fastest and easiest way to access information from users. All information will be collected and given numbers for analysis (C Golinski, 2009). The conclusions drawn from quantitative research will be general in nature from the majority of users. Therefore, the way to collect data from users according to this method is survey.

Survey is the use of a set of questions to collect information about people related to thoughts and actions. The results of the collected information will be statistically numerical.

- Qualitative research

Qualitative research is collecting customer data mainly in text form. The data will be analyzed and given results based on the number of occurrences of problems for each user and the importance of each problem based on the context of each data (Iztok Devetak, 2010). Therefore, the ways to collect data from users by this method are focus group and one on one interview.

Focus group is the way to get the most information from users, personal opinions will be clearly understood. The process will involve a group of people and the result will be text documents.

One on one interview is an individual interview for each user. Based on each person's personal opinion and the results will be the most detailed.

2. The question(s) for the research study.

As mentioned above, the research will use two methods to carry out including qualitative research and quantitative research. Questions to use in surveys, focus groups, and interviews are outlined below.

The questions of focus group

1. Have you ever used in-car entertainment or similar devices?
2. What do you think about in-car entertainment? And what has it been useful to you in the past?
3. What features do you like in in-car entertainment?
4. How do you evaluate the navigation system in the car?
5. What difficulties have you encountered when using in-car entertainment?
6. Which feature on in-car entertainment do you think is better than on smartphones? and why?
7. In your opinion, what features should in-car entertainment have?

The questions of interview

1. Some car drivers think that in-car entertainment is as functional and convenient as a smartphone. What do you think about that?
2. What features do you like in in-car entertainment? and why?
3. What do you think about the operation, icon image and animation of in-car entertainment?
4. While using a car, do you prefer to use the navigation system on your smartphone or the navigation system available in-car entertainment? and why?
5. The last question, what features would you like in-car entertainment to have in the future?

The question of survey

1. How can you "turn on Bluetooth"?
2. How do you find your "current location"?

3. Identify research objects and users.

According to (Frascara, 2002), Performing research needs to clearly define the problem and its correlation, or performing a design of a user interface also needs to clearly define the target audience. The user data will be centralized to better understand the needs and requirements of the user. Therefore, user-centered design is an easy way to help designers develop an application, a user-friendly interface.

Based on the foregoing, the targeted audience will be those who are older than 18 years of age or are at the age of majority according to the laws of each country. Gender includes male, female and others. People who already know how to use the car entertainment interface, who know how to use smartphone devices and similar devices like smartphones. Through these objects, designing the car entertainment interface with the navigation system will be the most intuitive and specific.

4. How to conduct and analyze research data.

Based on the identification of the user approach (Frascara, 2002), the research will choose according to the two mentioned methods, qualitative research, and quantitative research. Activity will include focus group, survey, and interview.

Focus group - The study will ask questions for 3 age groups. The first is the age group from 18 to 25 years old, they are young people and will bring new results to the entertainment system. The second age group is between 26 - 45 years old, the design is targeted towards a group of people since they are the people of the family-building age. The last age group is older than 45 years. The final age group will provide safety solutions or results for the entertainment system such as safety warning or notification features. Therefore, using Google form of the platform provided by Google will help quickly get information about the needs of each age group.

Survey - The implementation process will be questions related to the process of performing some of the common operations people use on devices similar to car entertainment systems. The questions will be done on the Optimal workshop. The results will be analyzed based on their operations and draw conclusions.

Interview - A meeting with the number of 2 people for them to try out the ability to use the domain of Axure and observe the operation. The troubles and difficulties when operating will be noted to complete the correction errors.

5. Project management

Based on the above definitions, the appropriate SDLC model to implement the project is the waterfall model

Waterfall model - The waterfall project management model is a project management methodology based on a sequential and sequential design process (Adetokunbo Adenowo, 2013). The phases in the project are executed one after the other, the new phase is only implemented when

the previous phase has been completed. The waterfall model will help manage projects and processes on time and with expected results.

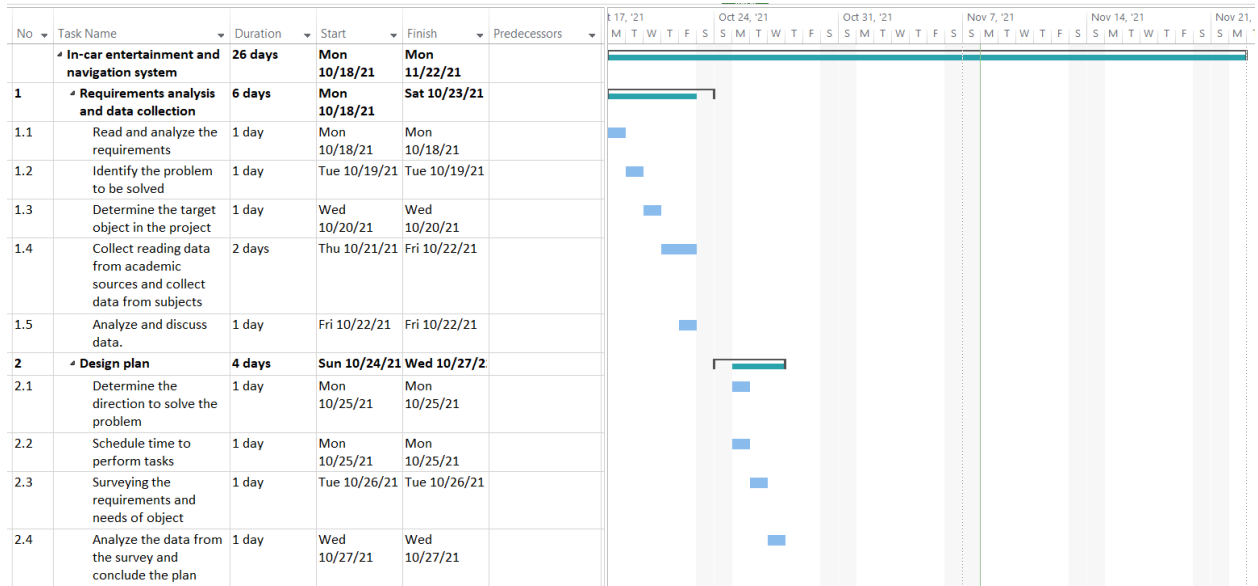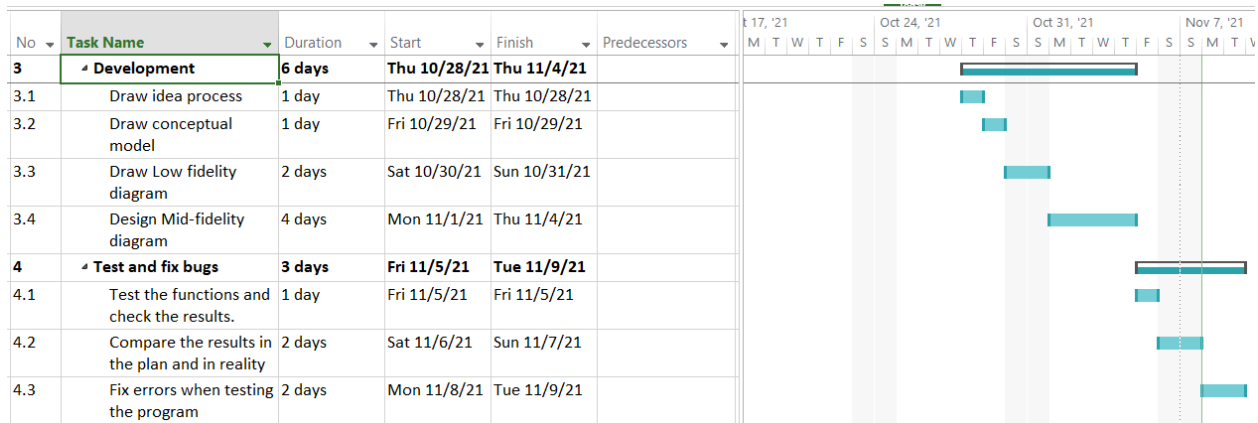**Gantt chart** - Below is the implementation process design based on waterfall model.

No	Task Name	Duration	Start	Finish	Predecessors
	⊿ In-car entertainment and navigation system	26 days	Mon 10/18/21	Mon 11/22/21	
1	⊿ Requirements analysis and data collection	6 days	Mon 10/18/21	Sat 10/23/21	
1.1	Read and analyze the requirements	1 day	Mon 10/18/21	Mon 10/18/21	
1.2	Identify the problem to be solved	1 day	Tue 10/19/21	Tue 10/19/21	
1.3	Determine the target object in the project	1 day	Wed 10/20/21	Wed 10/20/21	
1.4	Collect reading data from academic sources and collect data from subjects	2 days	Thu 10/21/21	Fri 10/22/21	
1.5	Analyze and discuss data.	1 day	Fri 10/22/21	Fri 10/22/21	
2	⊿ Design plan	4 days	Sun 10/24/21	Wed 10/27/2	
2.1	Determine the direction to solve the problem	1 day	Mon 10/25/21	Mon 10/25/21	
2.2	Schedule time to perform tasks	1 day	Mon 10/25/21	Mon 10/25/21	
2.3	Surveying the requirements and needs of object	1 day	Tue 10/26/21	Tue 10/26/21	
2.4	Analyze the data from the survey and conclude the plan	1 day	Wed 10/27/21	Wed 10/27/21	

Figure 6. Gantt chart.

No	Task Name	Duration	Start	Finish	Predecessors
3	⊿ Development	6 days	Thu 10/28/21	Thu 11/4/21	
3.1	Draw idea process	1 day	Thu 10/28/21	Thu 10/28/21	
3.2	Draw conceptual model	1 day	Fri 10/29/21	Fri 10/29/21	
3.3	Draw Low fidelity diagram	2 days	Sat 10/30/21	Sun 10/31/21	
3.4	Design Mid-fidelity diagram	4 days	Mon 11/1/21	Thu 11/4/21	
4	⊿ Test and fix bugs	3 days	Fri 11/5/21	Tue 11/9/21	
4.1	Test the functions and check the results.	1 day	Fri 11/5/21	Fri 11/5/21	
4.2	Compare the results in the plan and in reality	2 days	Sat 11/6/21	Sun 11/7/21	
4.3	Fix errors when testing the program	2 days	Mon 11/8/21	Tue 11/9/21	

Figure 7. Gantt chart.

No	Task Name	Duration	Start	Finish	Predecessors
5	⊿ Deployment and survey	8 days	Wed 11/10/21	Fri 11/19/21	
5.1	Plan questions for survey and interview	2 days	Wed 11/10/21	Thu 11/11/21	
5.2	Survey và interview người dùng.	2 days	Fri 11/12/21	Mon 11/15/21	
5.3	Analyze data collected from surveys and interviews	2 days	Tue 11/16/21	Wed 11/17/21	
5.4	Fix new bugs and fix features according to common needs.	2 days	Thu 11/18/21	Fri 11/19/21	
6	⊿ Conclusion	3 days	Thu 11/18/21	Mon 11/22/2	
6.1	Write a report on the implementation process and the evidence provided	3 days	Thu 11/18/21	Sun 11/21/21	
6.2	Plan to update the program in the future	0.5 days	Mon 11/22/21	Mon 11/22/21	
6.3	Submit reports and blueprints, relevant evidence.	0.5 days	Mon 11/22/21	Mon 11/22/21	

Figure 8. Gantt chart.

V - Design Process

1. Assumption

The assumption made in this study is that **Those who are used to smartphone devices are likely to use in-car entertainment well, or difficulties appear only at the first few uses.**

2. Results from Questionnaires

2.1. Result from focus group

Question 1:

Figure 9. Question survey.

The results showed that 100% of the participants knew about the car entertainment system or similar devices such as mobile, ipad and others.

Question 2:

What do you think about in-car entertainment? And what has it been useful to you in the past?

Figure 10. Question survey.

I quite enjoy using the entertainment features in the car. In the past, I often listened to music in the car because I felt relaxed during a long road trip.

I think the camera backup feature makes it easy for me to move around

The car entertainment system is like the brain containing the vehicle's information. I quite like it because it makes it possible for me to ride the car and answer the phone at the same time.

I found it to have a lot of great features. I love to go places and fortunately the geolocation feature helped me.

The car audio is great, I use it to make the trip not boring.

Every time I go to my father's car, I always use the music feature because listening to the sound in the car is too perfect

I'm a taxi driver, so car navigation is very important to me.

Figure 11. Effects of the entertainment system.

The answers show that they have generally very positive views about the features and applications in the car entertainment system. Some of the answers mentioned music, maps, and camera apps.

Question 3:

What features do you like in in-car entertainment?

Figure 12. Question survey.
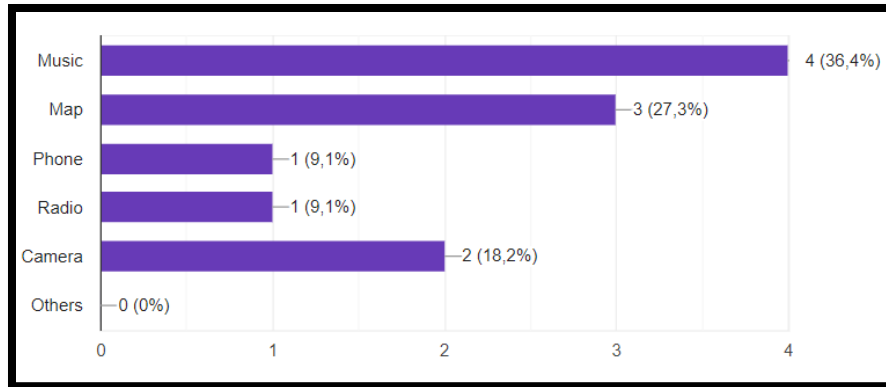
Figure 13. Applications users like.

The most favorite selected feature is Music and Map, in addition, Camera, Radio and Phone features are loved but not too much.

Question 4:

Figure 14. Question survey.

Figure 15. Evaluation of the positioning feature.

The results show very positive reviews from users for the car navigation feature. There are almost no complaints about how this feature works. The ability to accurately locate is mentioned a lot by users.

Question 5:

What difficulties have you encountered when using in-car entertainment?

Figure 16. Question survey.

I think I have no trouble using it

Some of the features are limited and there's no voice recognition, which is probably hard for me.

I think the music feature is still a bit limited because I want to listen to more songs but it doesn't have an online search mode.

I do not have.

Not yet

Other than the music feature, there are other features I haven't used too much but I find it not too difficult to use once I get used to it.

I haven't had any trouble using it yet

Figure 17. Problems.

The above results show that users have not encountered any serious difficulties. However, there are still difficulties when the music feature should be developed more so that users can search for new songs.

Question 6:

Which feature on in-car entertainment do you think is better than on smartphones? and why?

Figure 18. Question survey.

The question compares the effect between the car navigation feature and the smartphone navigation feature. This gives access to the convenience of a phone because nowadays smartphones have quite an important influence on everyone.

Certainly, the car's navigation feature is better than that on a smartphone. Because it's more convenient and easy to move to many places without having to hold the phone

I mean the camera backup feature because there is no such feature on the phone.

I think the car navigation feature is better. Because using a car, holding the phone is quite difficult to drive

I choose car navigation, because I never use my phone when I'm driving.

Car navigation will be better. Although I use both, I still think it's more convenient to use the car if I'm driving

I think it's better in the car. Because I think I can both drive and find a way to move.

I chose car navigation because it's right there in my vehicle, so I don't need a lot of other devices to find my way.

Figure 19. Compare the actual capabilities of the location feature.

Everyone wants to choose the navigation feature in the car. Opinions show that the car navigation feature is more useful than the phone location feature when the user is driving or using the car.

Question 7:

In your opinion, what features should in-car entertainment have?

Figure 20. Question survey.

The question determines the need to use the application and build the application system that the user actually wants to use.

Figure 21. Applications recommended by users.

Many attractive features are mentioned by users in the answer. However, the design will remove some distracting applications and will consider the practical capabilities of some applications.

2.2. Result from interview

Answers from two users of iPhone:

1. I think that listening to music in the car entertainment system will help me relax and not be stressed during long-distance driving.
2. I definitely love the music playback feature of the car entertainment system. Because this keeps me stress-free.
3. Some icons, animations of some features help me immediately understand what the task of that feature is. It's easy because you don't have to learn but you also know how it works.
4. Of course, I would choose the navigation system available in the car. Because it is extremely convenient when I have to drive and find my way at the same time.
5. I think it would be great if there was a video call feature, although I am very satisfied with the current car entertainment system.

Answer from a Samsung user:

1. I agree, because during the time I'm driving, the entertainment system helps me relax a lot.
2. I quite like the rear camera feature, it helps me see things behind the car when I reverse the car.
3. I'm not too impressed with this.

4. The car navigation system is my pick. I quite like using it because going to many places I can't remember all the roads.

5. Private security feature, because I don't want anyone else to be able to use my in-car entertainment system.

Overall - The responses of the interviewees showed that the features are almost the same so that phone users can use the applications found in the car entertainment system.

2.3. Result from survey

Based on the results obtained from the survey, the overall assessment can be found that the number of participants is eight people. The responses of the participants did not exceed one minute and the answer completion rate was 100%.

Participant	Status	Time taken	Tasks completed	Tasks skipped	Tasks successful	
Participant 2	Completed	0:30	100%	0	100%	Actions ∨
Participant 3	Completed	0:56	100%	0	100%	Actions ∨
Participant 4	Completed	0:22	100%	0	100%	Actions ∨
Participant 5	Completed	0:17	100%	0	100%	Actions ∨
Participant 6	Completed	0:30	100%	0	100%	Actions ∨
Participant 7	Completed	0:32	100%	0	100%	Actions ∨
Participant 8	Completed	0:44	100%	0	100%	Actions ∨

Figure 22. Results from survey Optimal workshop.

All selection operations start from "Setting". That shows that the user's mindset when they want to set up a certain feature starts with the "Setting" feature. Then select "Bluetooth" and select "Turn on".

1. How can you turn on Bluetooth?			
Setting > Bluetooth > Turn on			Showing 7 of 7 participants
Success	Participant	Path	
■	2	> Setting > Bluetooth > Turn on	
■	3	> Setting > Bluetooth > Turn on	
■	4	> Setting > Bluetooth > Turn on	
■	5	> Setting > Bluetooth > Turn on	
■	6	> Setting > Bluetooth > Turn on	
■	7	> Setting > Bluetooth > Turn on	
■	8	> Setting > Bluetooth > Turn on	

Figure 23. Results from survey Optimal workshop.

Users who have correctly selected "Map", that can see the design interface is not complicated to use the necessary features. Users may need to use "Map" to find their way right then and there and not have to go to "Settings" or use too many operations.

2. How do you find your current location?			
Map			Showing 7 of 7 participants
Success	Participant	Path	
■	2	> Map	
■	3	> Map	
■	4	> Map	
■	5	> Map	
■	6	> Map	
■	7	> Map	
■	8	> Map	

Figure 24. Results from survey Optimal workshop.

Overall - The results show that it is easy for users to use well and requires no instruction.

3. How five different dimensions of interaction design was applied

The above sections have mentioned the concepts of five dimensions. Based on the highlights and helping the design to have good interaction with users. The designs applied by the five dimensions are shown below.

Dimension 1 – Words

Words are used simply and understandable like Call, Contacts, Recent, and Keyboard. The simple words in the Phone feature of in-car entertainment make it easy for users to see and understand, and the construction layout is not causing layout disturbances on the screen.

Figure 25. Applies Words

Dimension 2 – Visual representation

Combined with the phone icon is the word "Call" that makes the icon image easier to understand. However, the Bluetooth icon does not need more words to explain and clarify because this icon image is too clear to help users understand that Bluetooth is turned on.
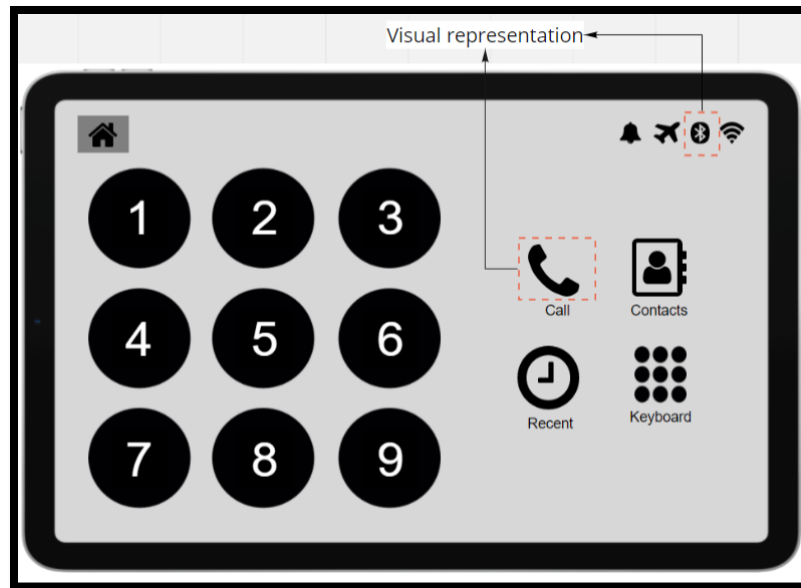
Figure 26. Applies Visual representation.

Dimension 3 – Physical object or space

The space is inside the car and above the car's large screen frame. Therefore, designs such as icons, images, notifications, and buttons need to be large enough for users to see and use operations on the screen. For example, the "Music" icon used is large enough that users in the car space can see.

Figure 27. Applies Physical object or space.

Dimension 4 – Time

Dimension - Time is user interaction animation and it will affect active user interaction. In the design, animation is used to switch from Wi-Fi icons to board icons.
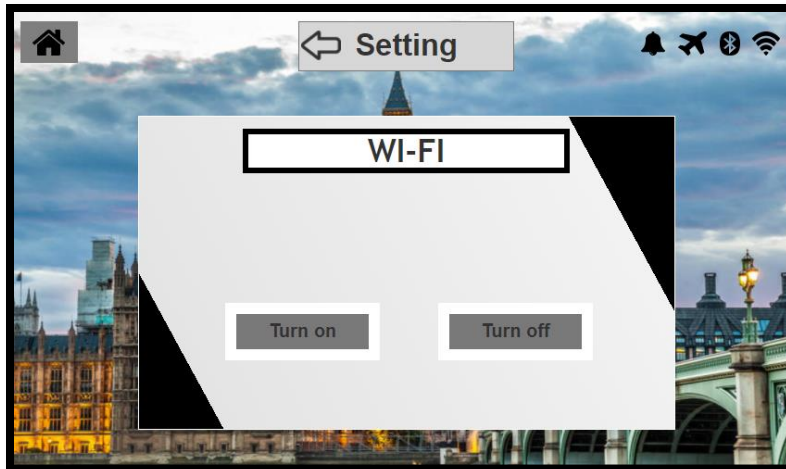
Figure 28. Applies Time.
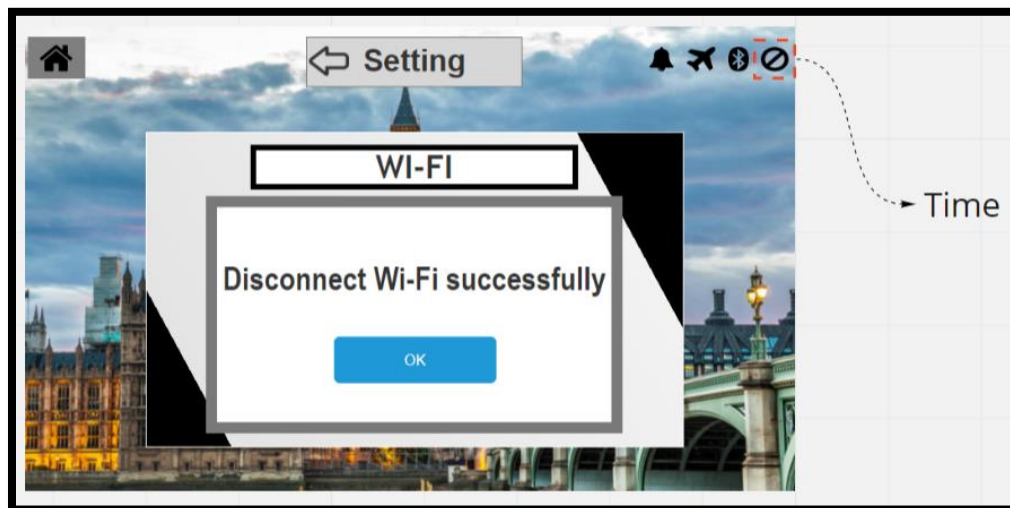
Figure 29. Applies Time.

When the user presses the "Turn off" button, the animation switches from the Wi-Fi icon to the ban icon.

Dimension 5 – Behavior

Applies with dimension 5 in the design is a synthesis using the above 4 dimensions. Text - a message, Visual representation - successful icon, Physical object or space, Time - animation of ban icon.

Figure 30. Applies Behavior.

VII - Conceptual Design

1. Ideation process

The idea is to design a car entertainment system to be safe for the driver, comfortable for the people in the car, and convenient to interact with the device in the car. Therefore, the main features that will be provided include Phone, Music, Map, Camera, Radio, and Setting. In addition, extra features include Bluetooth, Wi-Fi, Airplane mode, Date and time, and others. However, the secondary features will not be presented below and only the main features will be presented as a mind map.
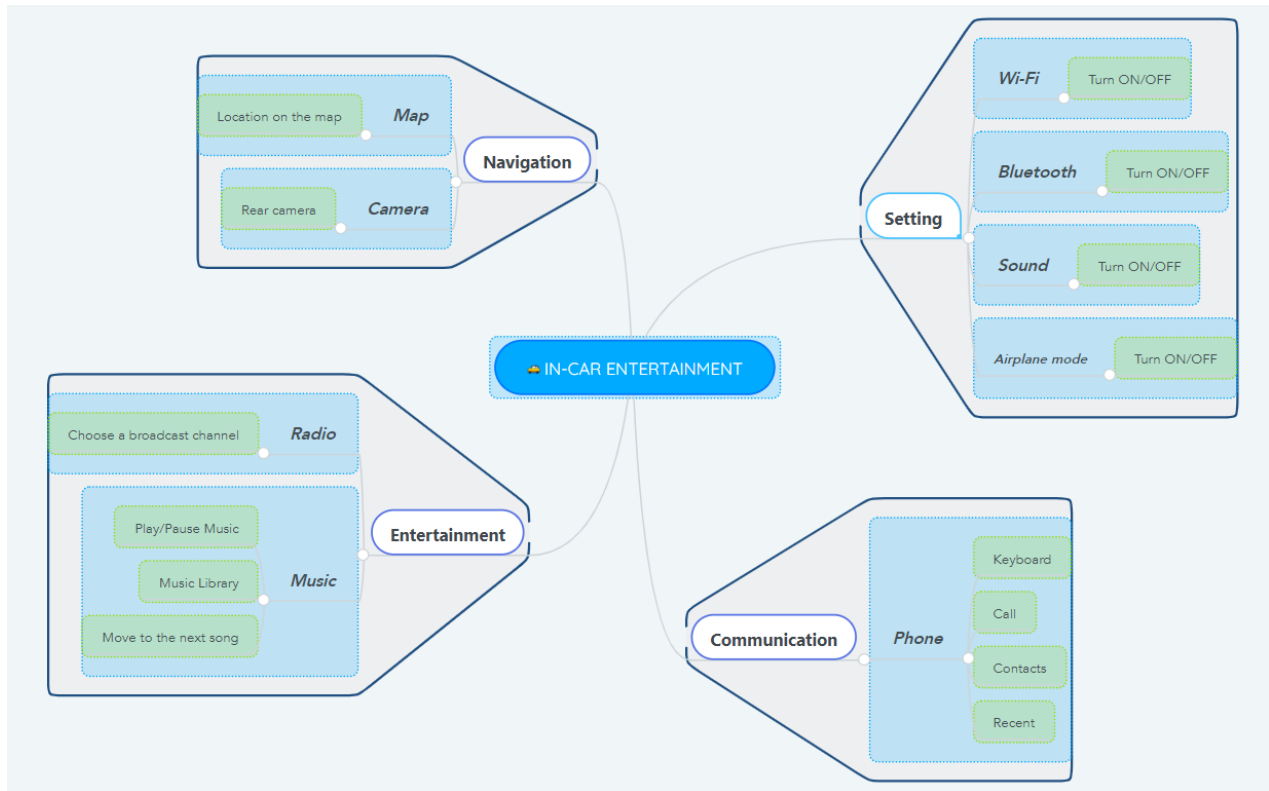
Figure 31. Mind map.

2. Conceptual Model

Below is the Conceptual Model of the project:
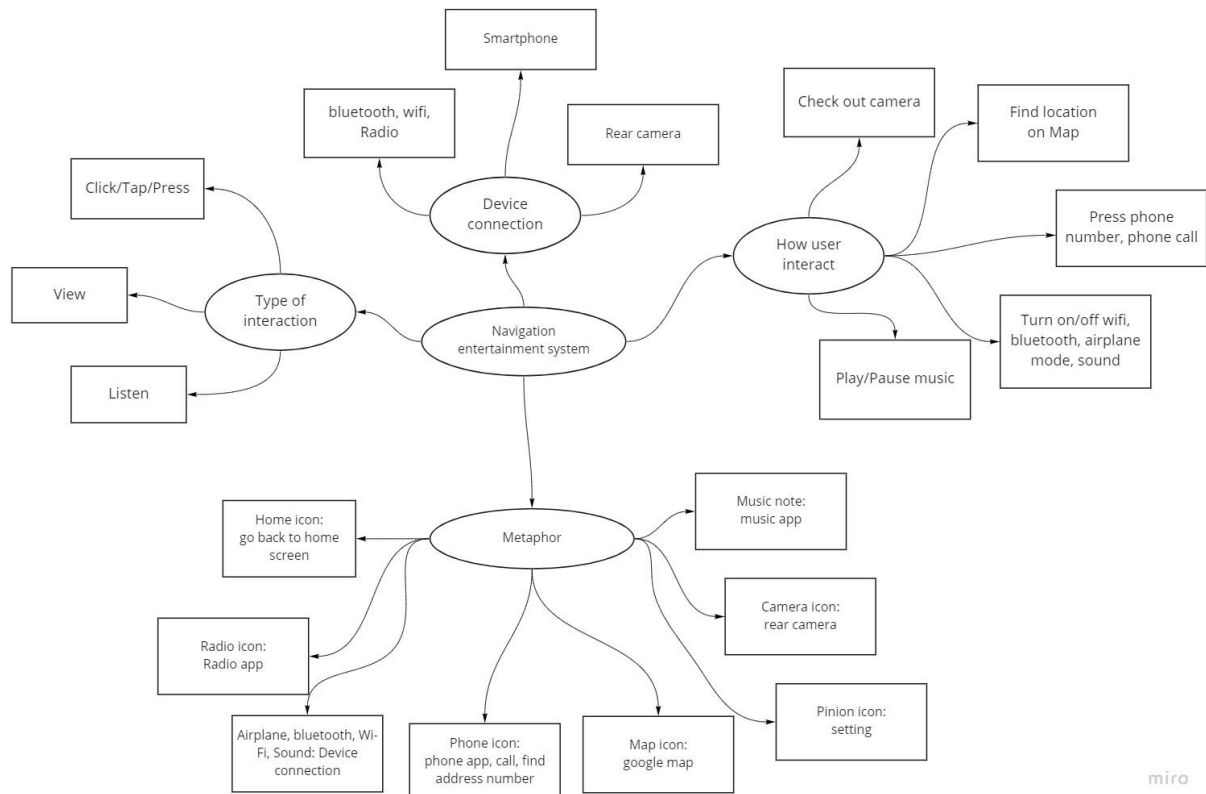
Figure 32. Conceptual Model.

VIII – Prototype

1. Low fidelity diagram

Below is a hand-drawn design of the user interface and in-car entertainment system.
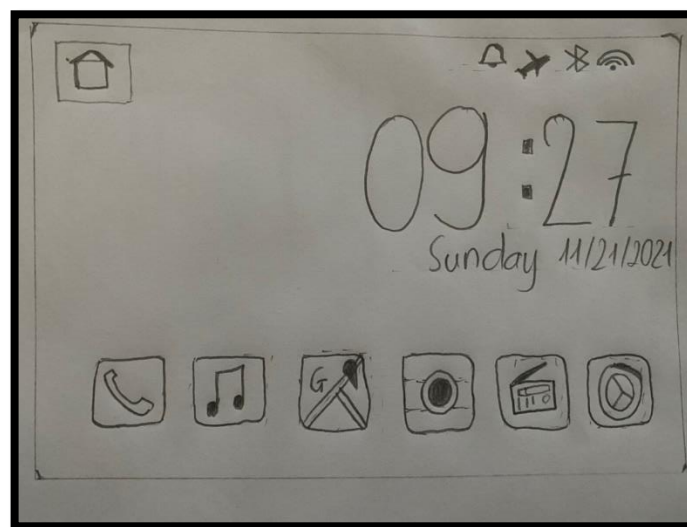
Figure 33. Home page.
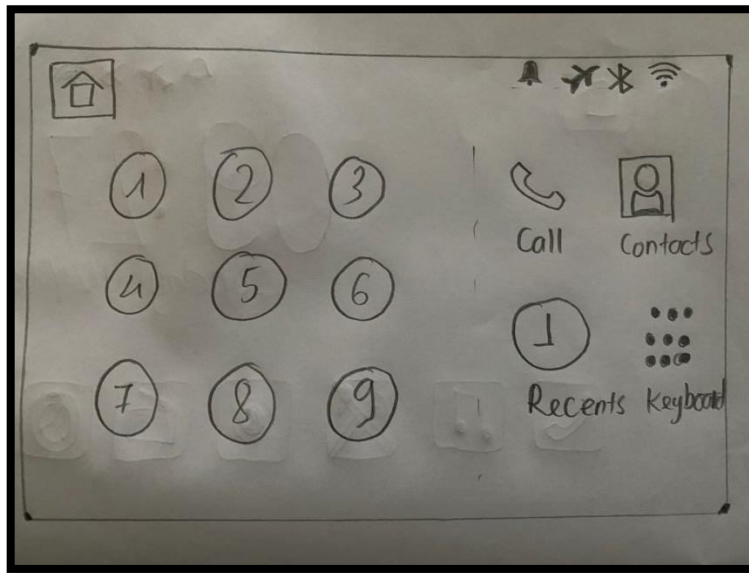
Figure 34. Phone function.
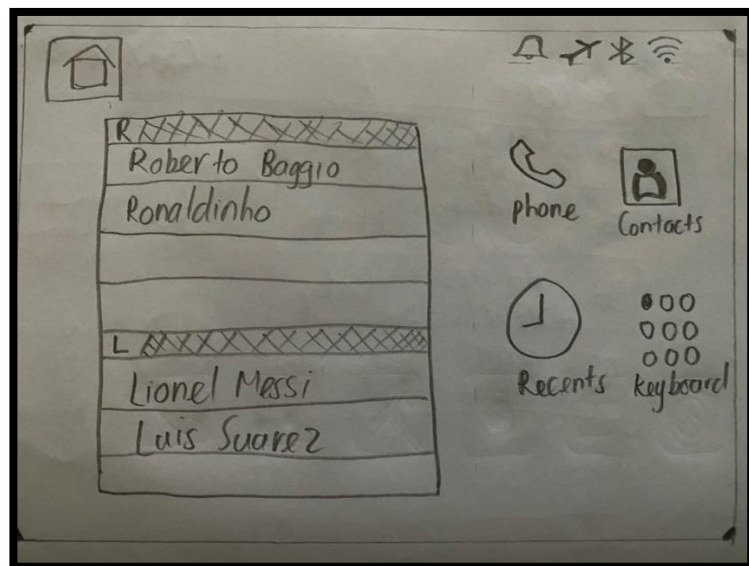
Figure 35. Contacts of phone function
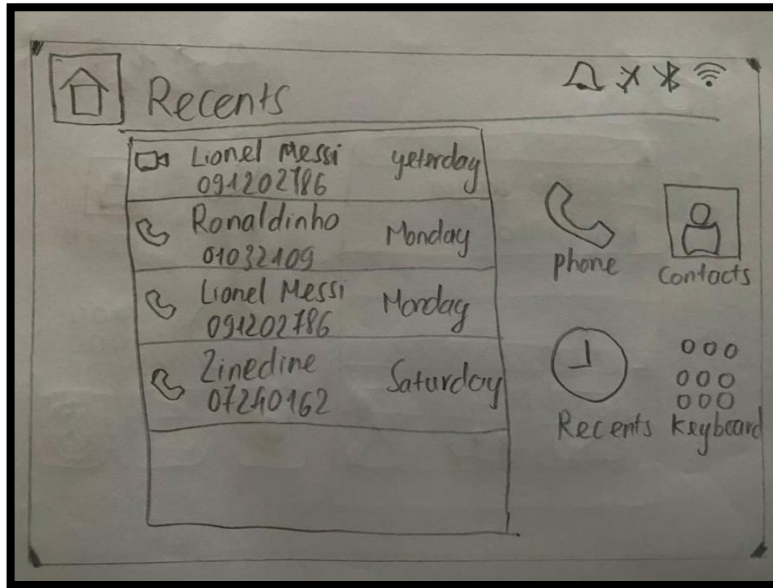
Figure 36. Recents of phone function.

Figure 37. Map.
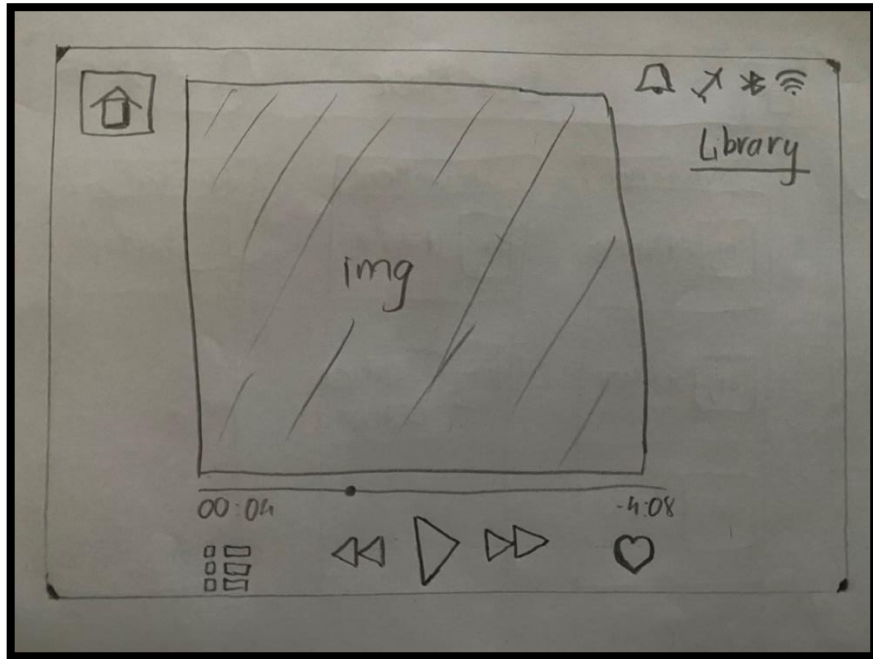
Figure 38.Music function.
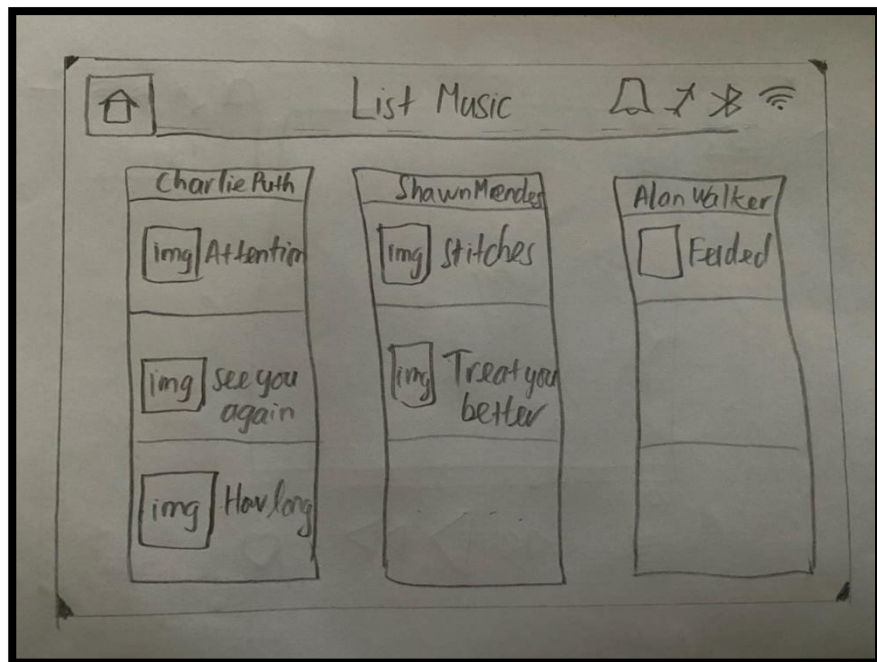
Figure 39. List music.
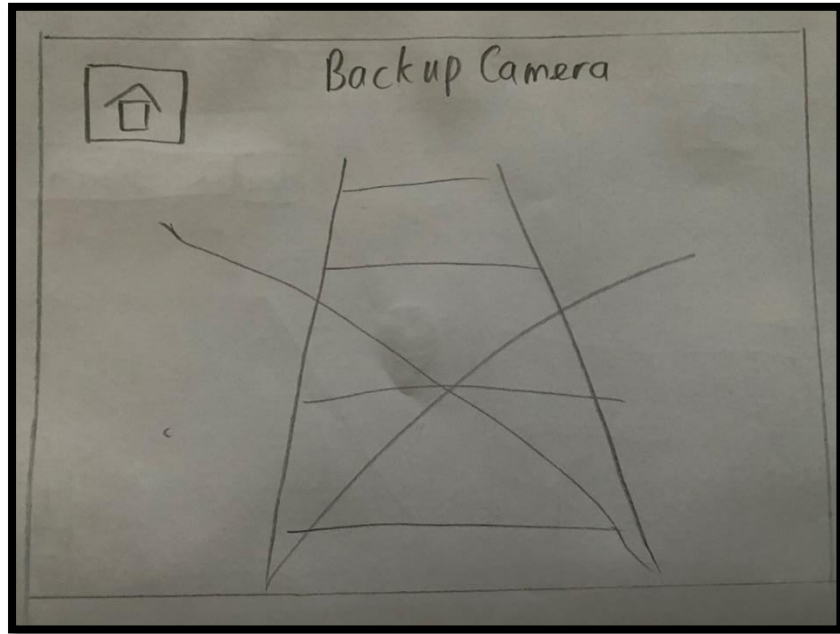
Figure 40. Backup Camera.
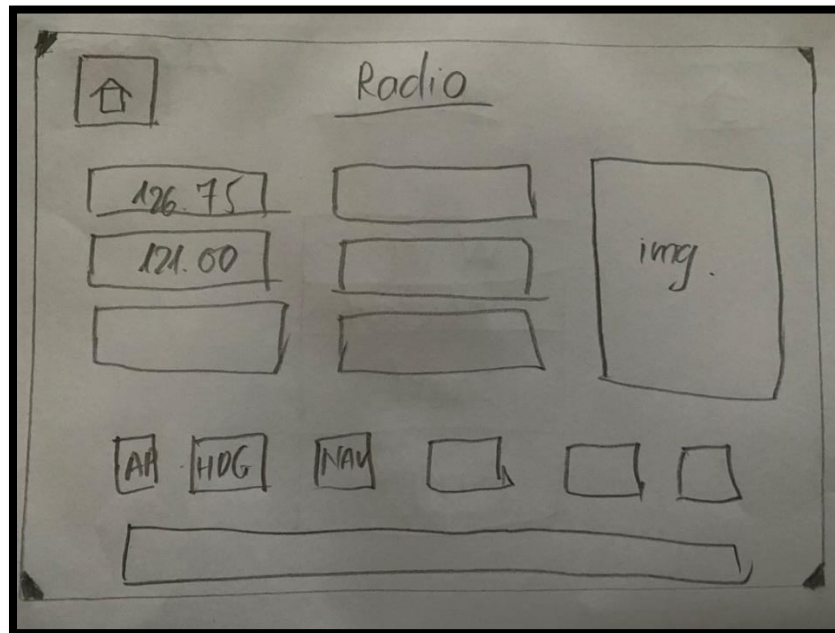
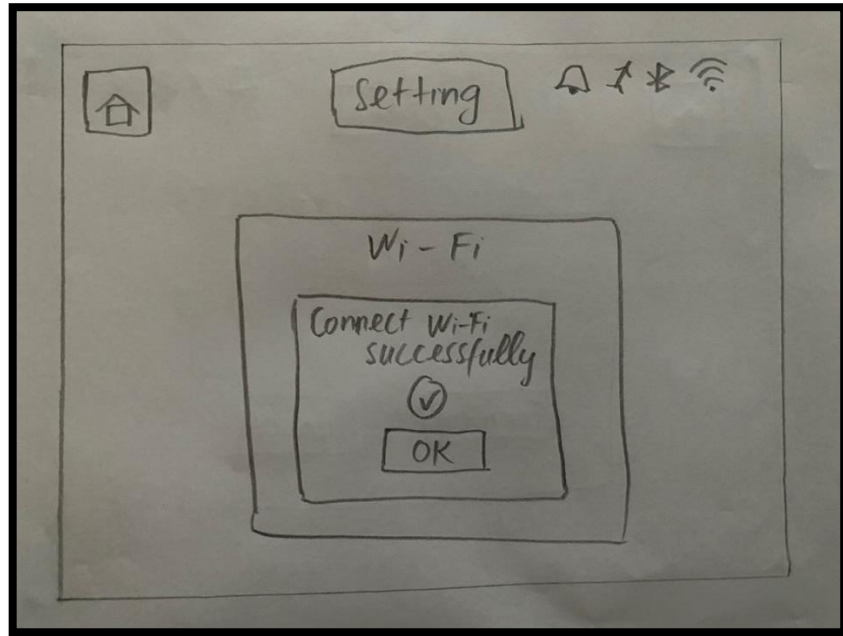*Figure 41. Radio function.*
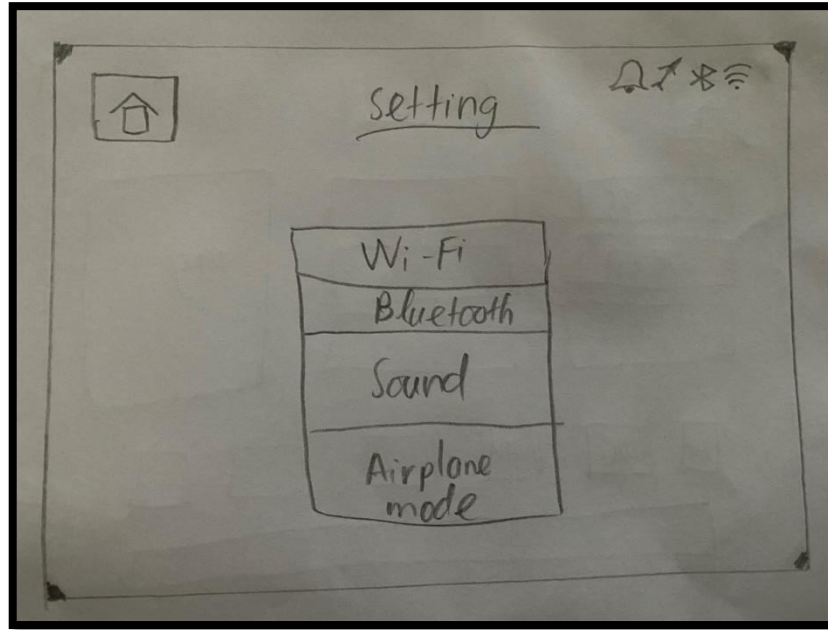
Figure 42. Setting page.
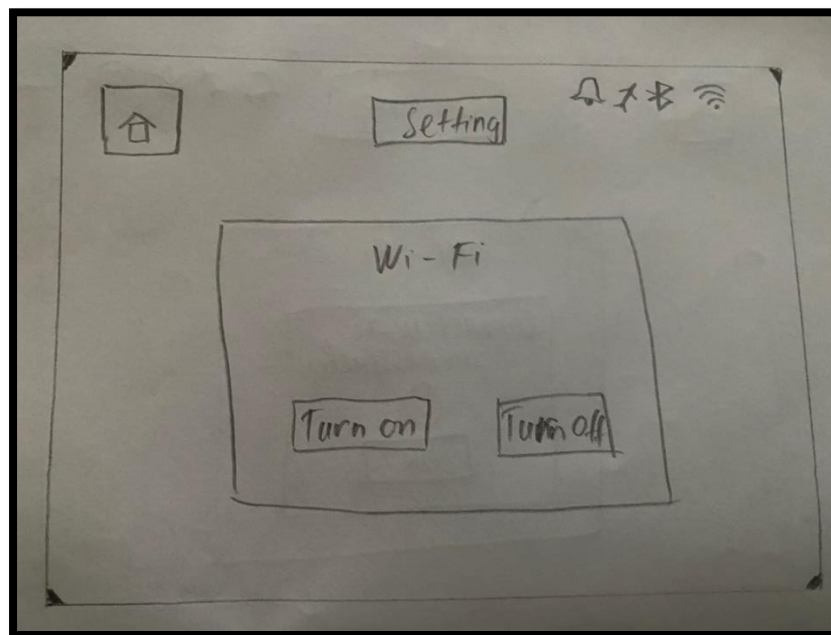
Figure 43. Setting Wi-Fi.

Figure 44. A message.

2. Mid-fidelity diagram

Below is a screenshot of the interface design of the in-car entertainment system using Axure
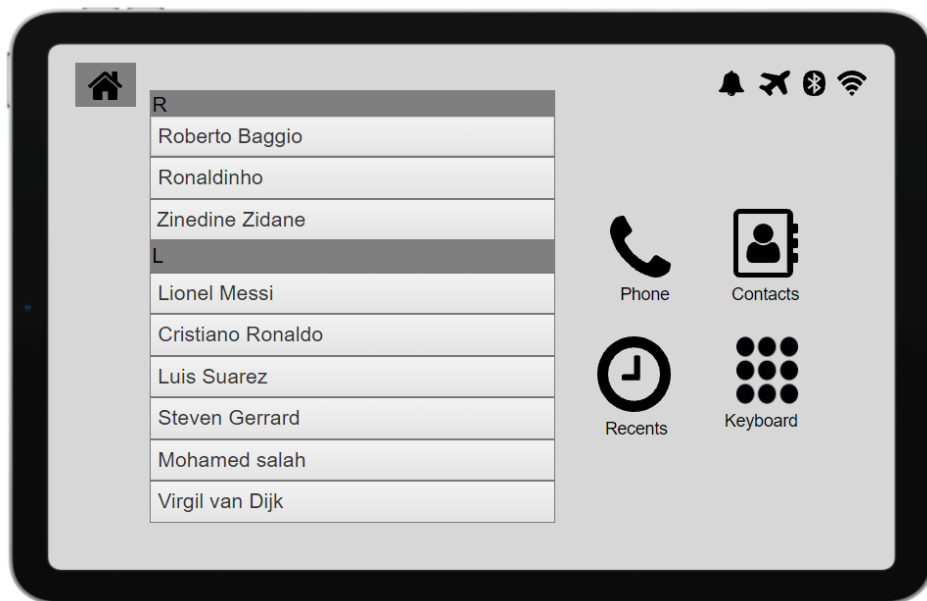

Figure 45. Home page.

Figure 46. Phone function.
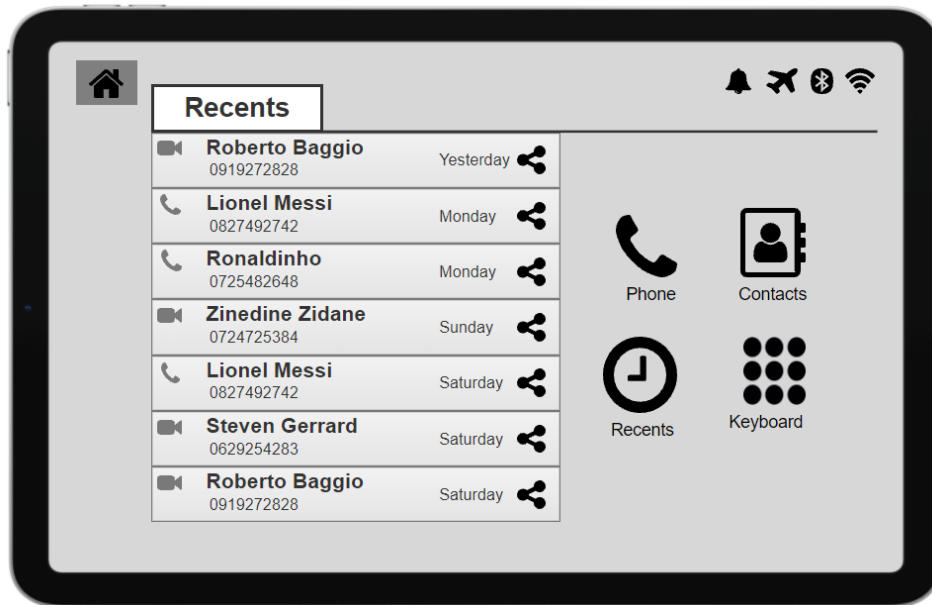

Figure 47. Contacts of phone function.
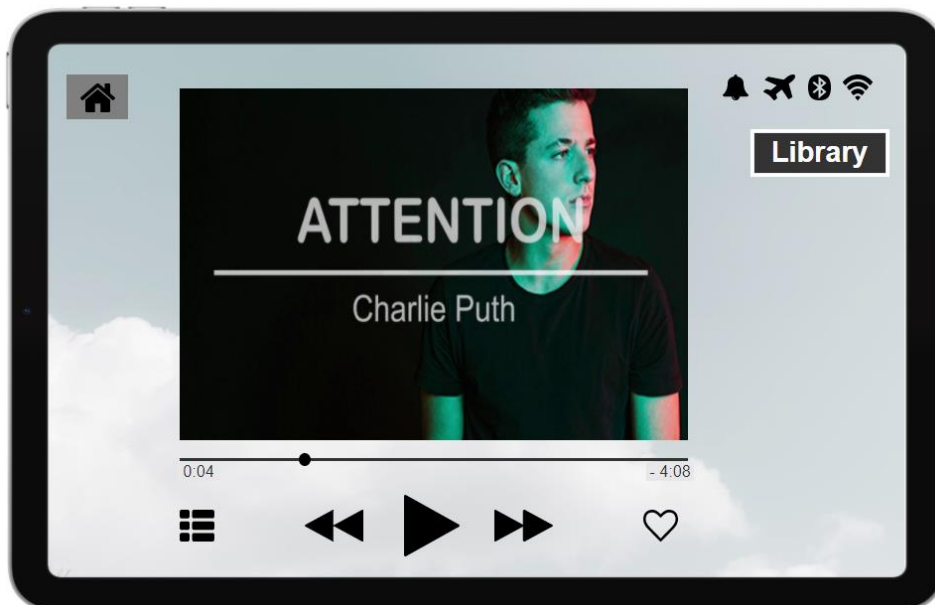
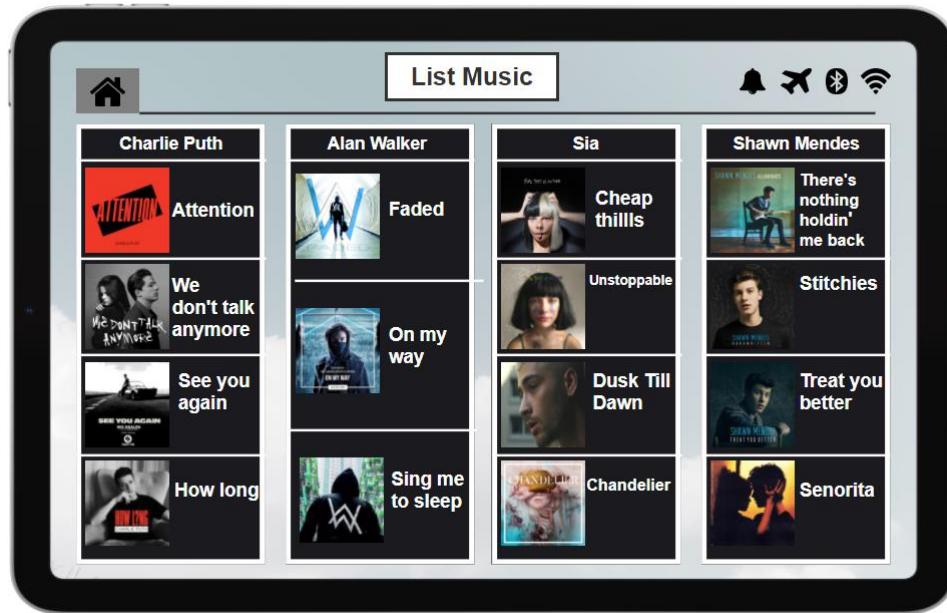*Figure 48. Recents of phone function.*

Figure 49. Music.
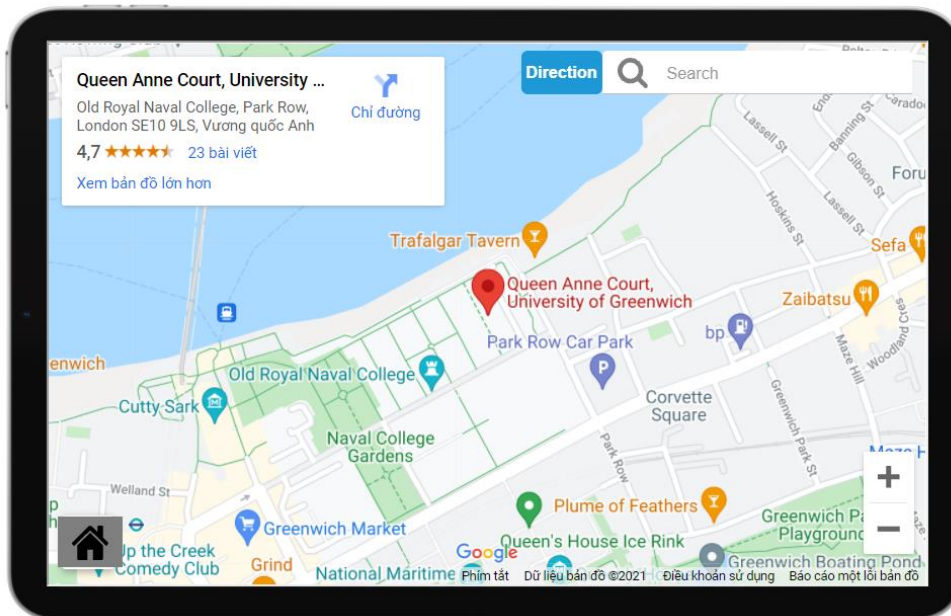
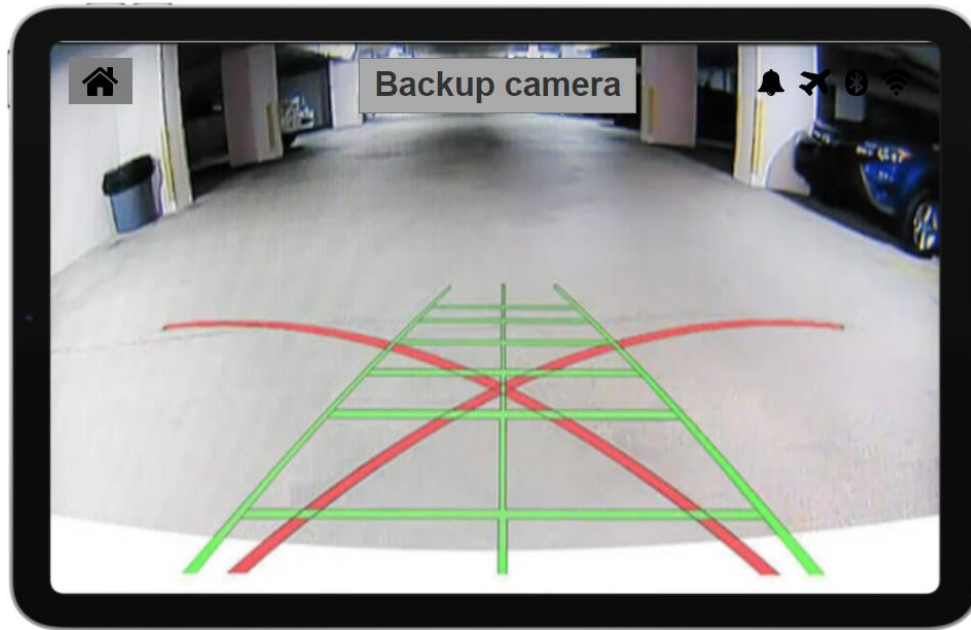*Figure 50. List music.*

Figure 51. Map.

Figure 52. Backup Camera.
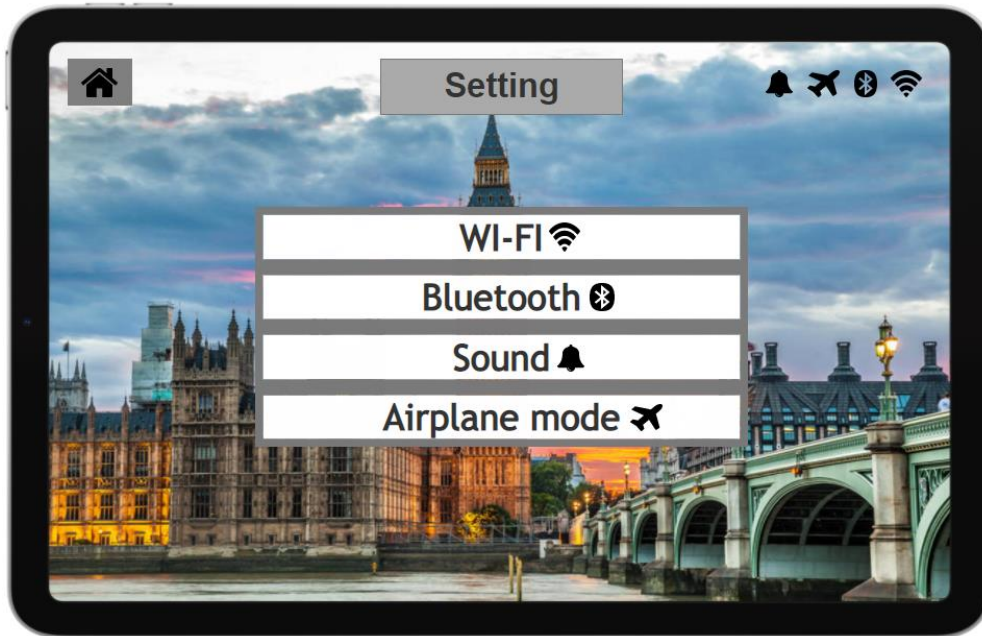

Figure 53. Radio.

Figure 54. Setting Page.

Figure 55. Setting Wi-Fi.

Figure 56. Connet Wi-Fi.
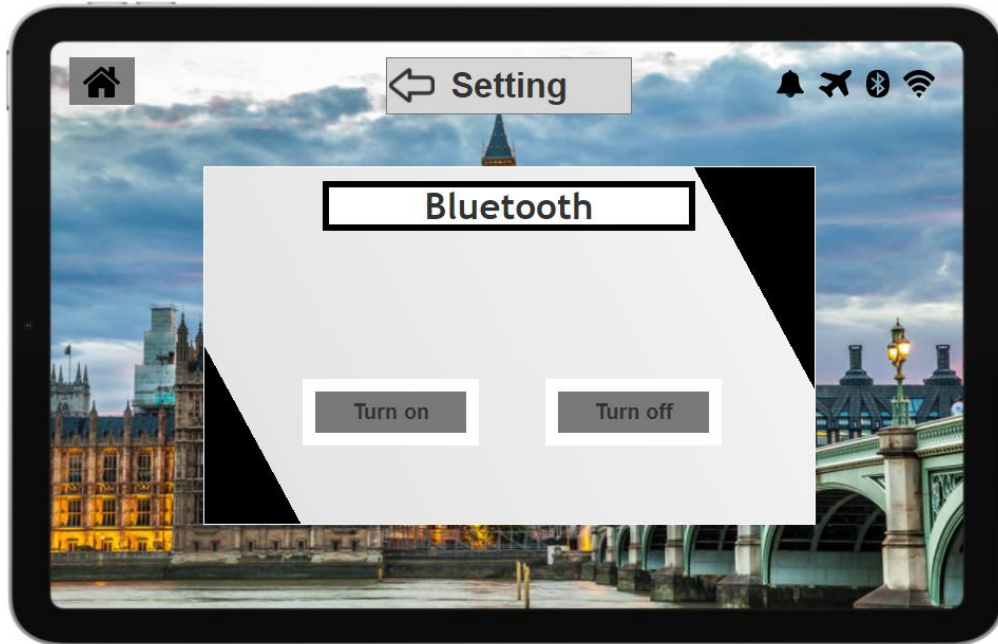

Figure 57. Disconnect Wi-Fi.
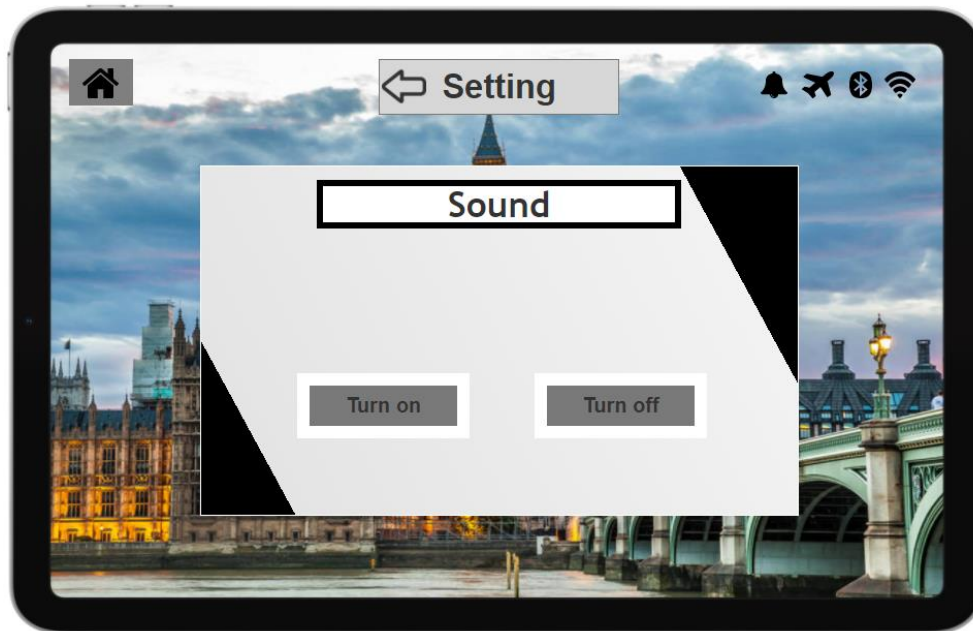
Figure 58. Setting Bluetooth.

Figure 59. Setting sound.

Figure 60. Setting airplane mode.

3. Link to Axure.

https://drive.google.com/file/d/12H7QnfYR02QqMs9wzhszLDLmNFoUrUCJ/view?usp=sharing

VI - Usability Testing

1. Preparation

Testing the user's usability of the design is the most intuitive way of judging. The method of choice for implementation is user interview. Based on direct observation, it is possible to accurately assess the user's reaction to the design.

2. Observation

As mentioned above, the method that will be used is the interview. Conduct face-to-face interviews with 2 people about how they use the features included in the design. Licenses are available to each person through publication and on a smartphone device. Based on direct observation of each person shows that:

- The first interviewer:

The first to use the device is the iPhone XS Max. The female gender and age are 20 years old. The ability to manipulate and use without much difficulty, easy to recognize all the features included in the design. Especially the navigation feature has been used to accurately locate the user's location. However, using Bluetooth on and off for the first time is still difficult because of the difference between the phone and the design for the car entertainment system. The general assessment when observing is good.

- The second interviewer:

The second user on the device is the Samsung Galaxy S10. Male gender and age are 28 years old. This person has used a car and knows how to use the car entertainment system. Therefore, the observation shows the ability to use it proficiently and without any difficulties during use. The user experience is good.

3. Key component questionnaires.

Question 1: What issues are you not satisfied with when using the car entertainment system?

The responses of the 3 interviewees all wanted a larger playlist and could search more songs on the internet. The problem they have is not being able to find the songs they want.

Question 2: Which feature impressed you the most? and why?

The most impressive feature is the location map search feature. It works very well and is accurate.

Question 3: What features do you think should be developed in the future?

Hardly too much of a problem and for them the only music feature should be extended playlists.

Conclusion

This report has provided the full design of the new in-car entertainment and navigation system based on the Axure design tool. Information related to the Waterfall project management model and five dimensions has been covered. The design implementation process, concept and related models are also provided clearly and in detail. Explanations and evidence related to the design have been provided with clear pictures. The report clearly presented all requested information and indicated the sources used.

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