CREATING CONCEPT AND A PROTOTYPE OF A NEW IN CAR ENTERTAINMENT AND NAVIGATION SYSTEM

HUMAN COMPUTER INTERACTION

3272 WORDS (exclusive table of content, reference and appendix)

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1. INTRODUCTION

As technology goes on, inventors and scientists keep creating new technologies to make our daily lives more convenient. New emerging technology known as IoT (Internet of Things) is steadily taking part in daily-to-day lives of most people (Sen, 2018). Without the need of human interaction, those devices can perform data transferring through internet. Most popular IoT devices (Smart devices) include remote control, healthcare monitoring, etc. (Minoli, 2013). There was a remarkable growth in the number of smart devices and it is predicted that the number of smart devices will be "several times" more than estimated population of the world (Silverio, 2018).

1.1 Framework for Designing Interaction

There are multiple frameworks when designing interaction and this project will be carried out through User centered design.

1.2 User centered design (UCD)

UCD framework mainly focuses on users in all design considerations and its stages includes

- Analysis and specify context of use
- Requirement specification
- Design solution
- Evaluate against requirements

(Anon., n.d.).

1.3 Justification

Having good usability is the most important criteria. UCD supports iterative designing process and make sure that the final product will have "Good Usability" (Lowdermilk, 2013). So, the development will be carried out according to the stages of UCD.

Analysis and specify context of use

2. User Analysis

2.1 Target Audience

For in-car system, main target users would be car owners who earn moderate amount of income because it costs averagely about $1000 to implement a good in car navigation system (autohaus, 2018). In Myanmar, it is needed to be over 18 to get a driving license (Anon., 2021) and most of people over the age of 50 are not familiar with in-car system. For navigation system, the main target audience would be the drivers. But for music library, users can be both drivers and passengers including teens who have average level of experience in technology. Therefore, primary target users would be drivers as well as car owners and secondary target users would be passengers including teens. Since teens are considered as target users, targeted audience for this system include people with the age of (15-45).

2.2 Questionnaire for Research

Survey questions have two parts: general questions and design questions. General questions focus on age of users and necessary functions for this system. Design questions will analyze which kind of color combination should be used and which types of designs users prefer.

According to COVID 19 pandemic and Political problems in Myanmar, research activities such as interviews and focus group are not easy to perform. So, online survey questions will be carried out through google forms. The participants in the survey would be neighbors, friends and people form the social media who meet criteria to be a target audience.

2.2.1 General Questions

For general questions images, see Appendix A.

2.2.2 Design Questions

For design questions images, see Appendix A.

2.3 Survey Result

Although survey is sent to 20 people, 17 responses are submitted. According to the survey result

- Over half of employed and unemployed persons have proper knowledge with in car system.
- Making voice command and alert boxes are comfortable for participants.
- Most people like a responsive slider to choose app.
- “Verdana” font-family with the font size of 30 would be most suitable for the system.
- Dark theme combined with blue color will be used in the system.

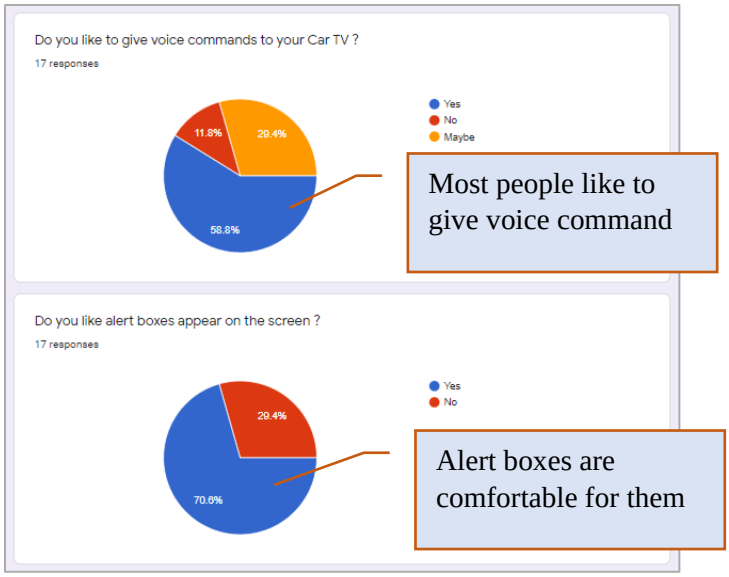

Fig.2.3.1

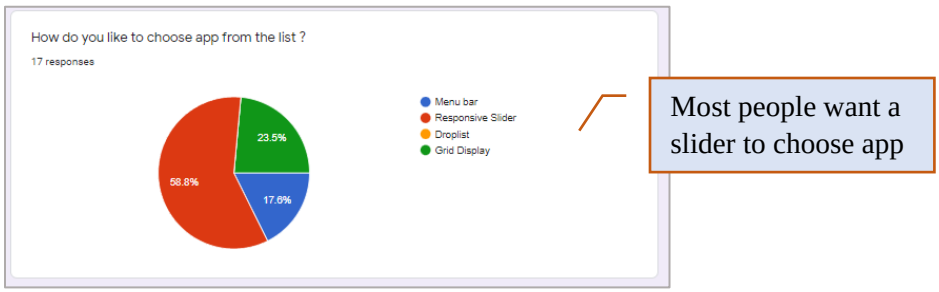

Fig.2.3.2

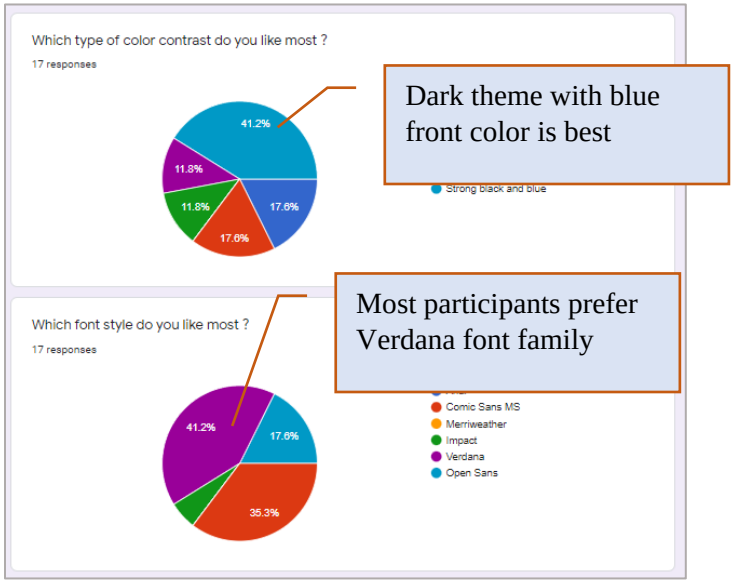

Fig.2.3.3

For remaining, see Appendix B.

Requirement Specification

3. Literature Review

3.1 Five dimensions of interaction design

When designing interactions, developers have to consider five dimensions which help having intuitive and meaningful communication between users and the screen. Moreover, designers can consider about different types of mode. Considering modes can help to have better user interface and improve behavior of the system.

(a) Words

Words play an important role in designing process and it help to have strong relationship between users and the system. The words used in in-car system should be familiar and understandable for user. And the chosen words must also directly represent the actions intended so that drivers or passengers would easily recognize them. There should be labels and simple instructions to increase the performance of users' interaction.

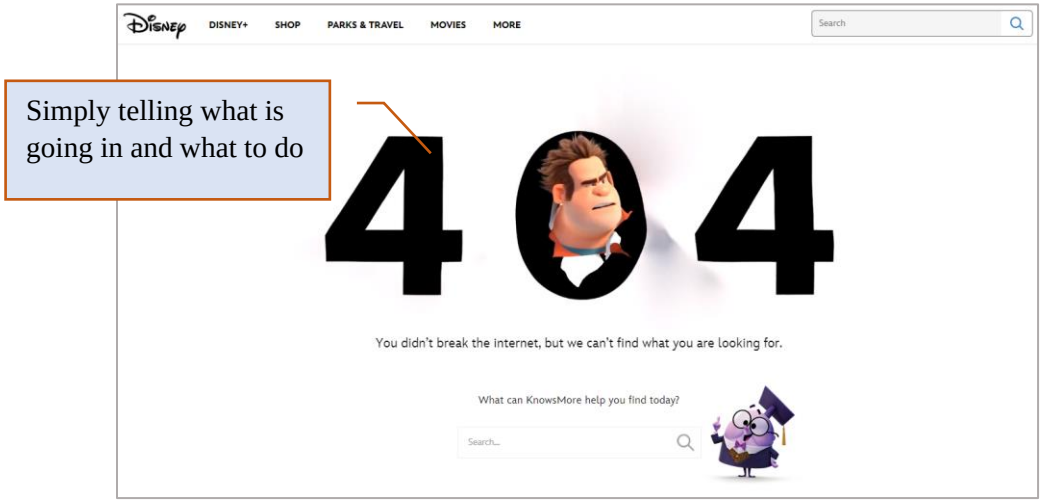

Fig.3.1.1 Source (https://www.searchenginejournal.com/404-page-examples/211154/#close)

(b) Visual representations

Apart from suitable words, using visual representations such as images, icons, diagrams in the system can help to increase users' interaction. Those visuals are not interactions but they are things that users will interact with (UXPin, n.d.). Using visual representations in navigation system can reduce complexity of user interface. Using understandable icons in menu and button would help users to recognize what it means just by looking at the icons.

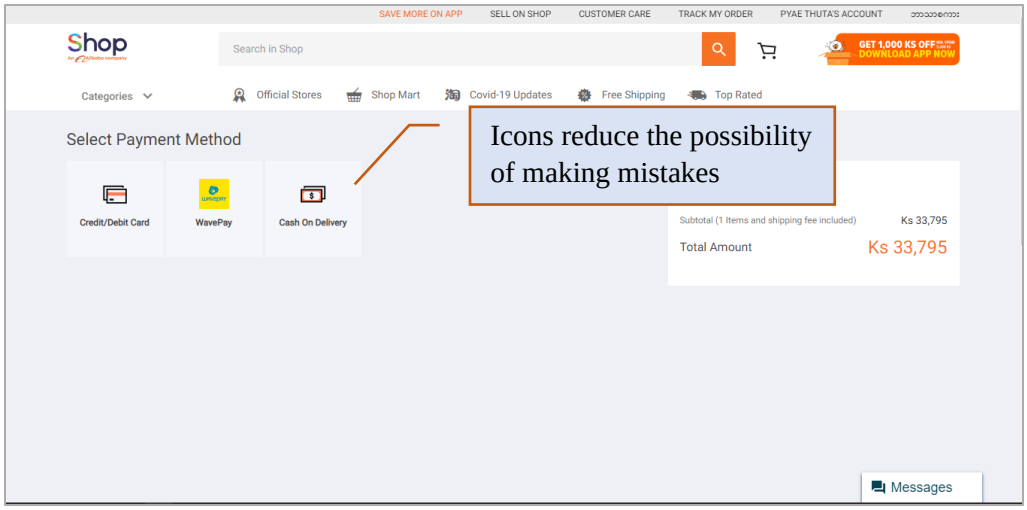

Fig 3.1.2 Source (https://www.shop.com.mm/)

(c) Physical object or space

This dimension includes understanding physical objects or devices that users will interact with the system. For in car system, the device will surely be a touch screen. So, buttons and links cannot have hover effects. Instead of adding hover effects, there should be other designs to make the buttons and links look clickable. And if users want to search songs or route, users cannot use a physical keyboard. So, there should be voice command system or virtual keyboard in the system.

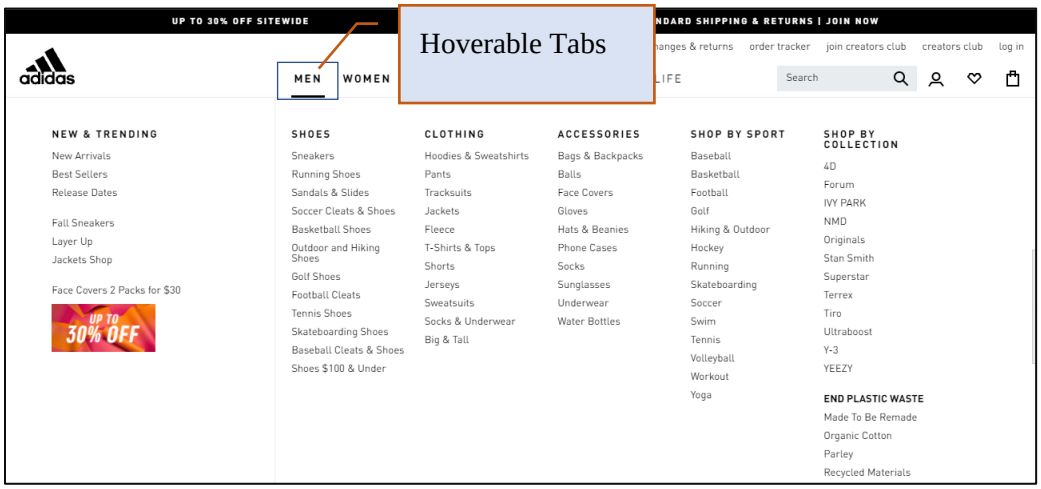

Fig.3.1.3 Source (https://www.adidas.com/us)

(d) Time

Time means interactions that are changing over time (e.g., sound, animation, video and so on). Those kinds of media also help in having better user's interaction. When users switch on the car TV, welcome animation will play for a moment which would make users feel more comfortable. Moreover, there should be warning message when users choose wrong route or the music volume is too loud. But the loading time of these animations should not take too much time since that can lead to interruption.

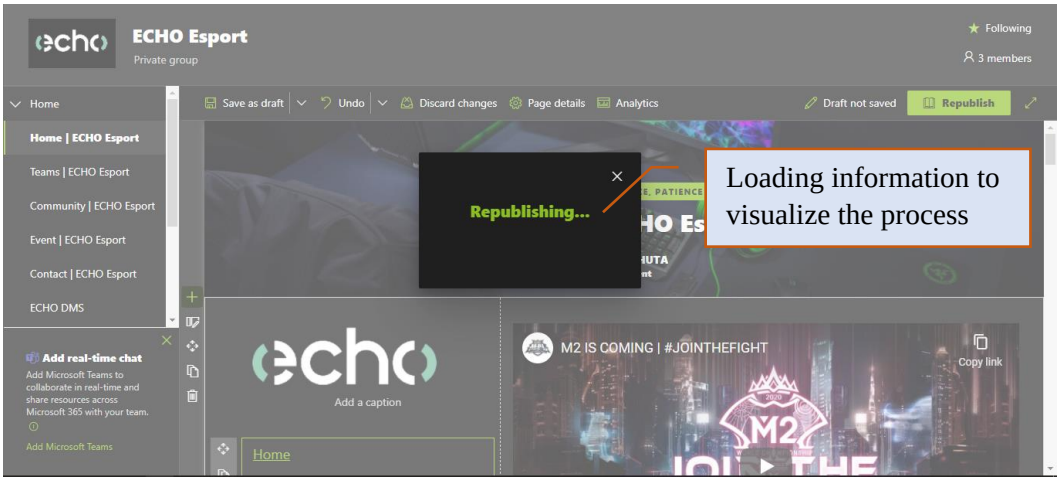

Fig 3.1.4 Source **(**https://www.microsoft.com/en-us/microsoft-365/sharepoint)

(e) Behavior

The last dimension of the interaction design refers to actions, operations, reactions and presentations which are the behavior of the system. It is exploring the reactions of users when interaction with the system. Showing success alert when destinated direction is arrived or deleting, creating a music playlist in library are simple and familiar behaviors for users. The behavior of the system must not be complicated and it should be totally understandable for users.

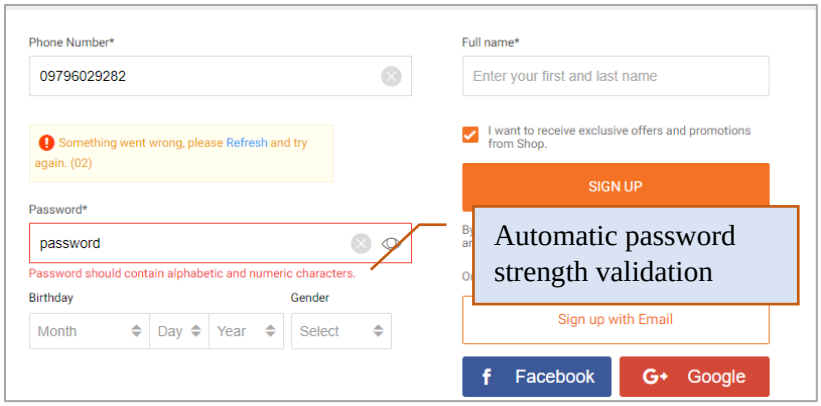

Fig.3.1.5

Source (https://member.shop.com.mm/user/register?spm=a2a0e.home.header.d6.672a7fe4n5Miqg)

3.2 Cognitive Psychology

Cognitive psychology is the psychology of understanding and knowing mental processes of human (Neisser, 1999). In this project of creating prototypes for a new in car system, following mental operations will be used.

(a) Attention

In cognitive psychology, attention is focusing on a process that is happening or being carried out. Although there are four main types of attention, selective attention and divided attention (Mazarin, 2021) will be considered in this project. Selective attention will be applied for in car navigation system because driver should focus only on navigation system when driving and the designs of navigation UI should grab user's attention. But for music playing, user does not need a large concentration on it unless wrong music is playing. The interface of car navigation system should not be clutter and it should display the information simply. There should be some simple alerts to remind users when music volume is too loud to concentrate on driving.

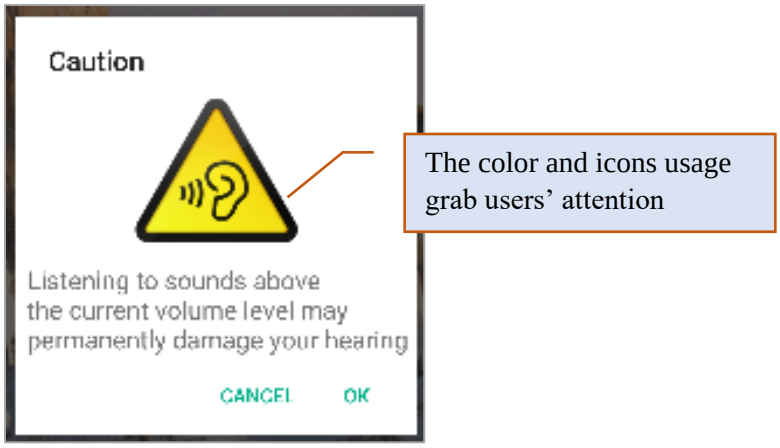

Fig 3.2.1 Source (https://www.codeproject.com/Tips/5271082/How-to-Disable-High-Volume-Warning-Message-on-Andr)

(b) Language and perception

Language is very important in communication and choosing right language influences a lot in cognitive processes (Dwinata, 2017). In Myanmar, people mostly understand English since it is taught as a second language (Nag, 2017). So, English language will be mainly used in this system so that users can easily communicate. Apart from using texts, understandable icons will be applied since icons reduce complexity of screen design by taking only little space (Jacko, 2007).

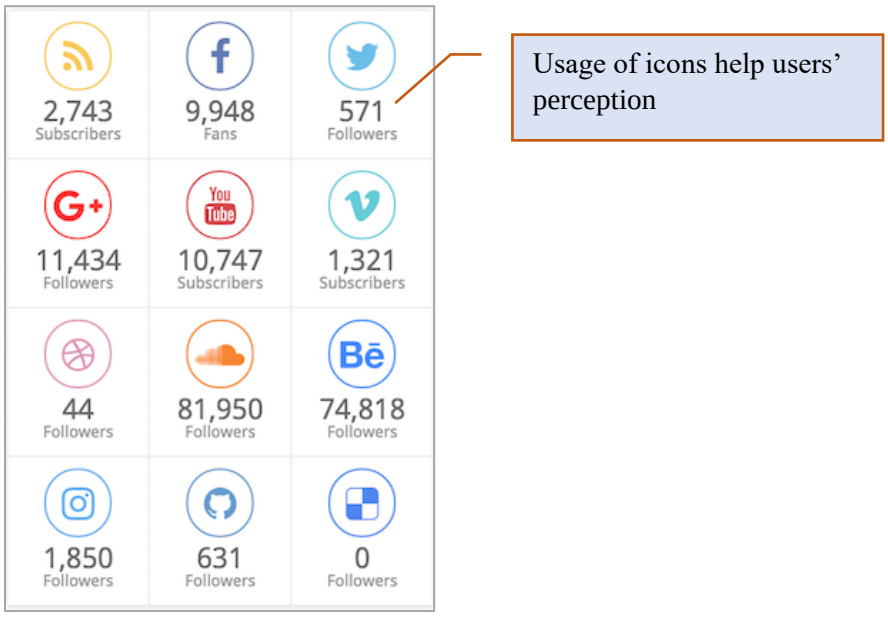

Fig 3.2.1 Source (https://sonysimon.com/web-development/icon-usage/)

(c) Memory

Memory is a process where an individual stores and retrieve complex information. There are three types of memory including sensory memory, short-term memory and long-term memory (Churik, 2009). Among them, short-term and long-term memory will be considered in creating prototypes for this system. According to Miller's magical number 7 plus or minus two (Derry, 1998), human can averagely aware of 2 to 7 items at a short period of time. So, information displaying on the screen should not be more than 7 (i.e., there should be maximum 7 items in app slider). The system must always provide users with alerts of which route he is going or which music is playing. The system will also apply suitable colors since it helps having better performance in memorizing certain information (Mustafar, 2013).

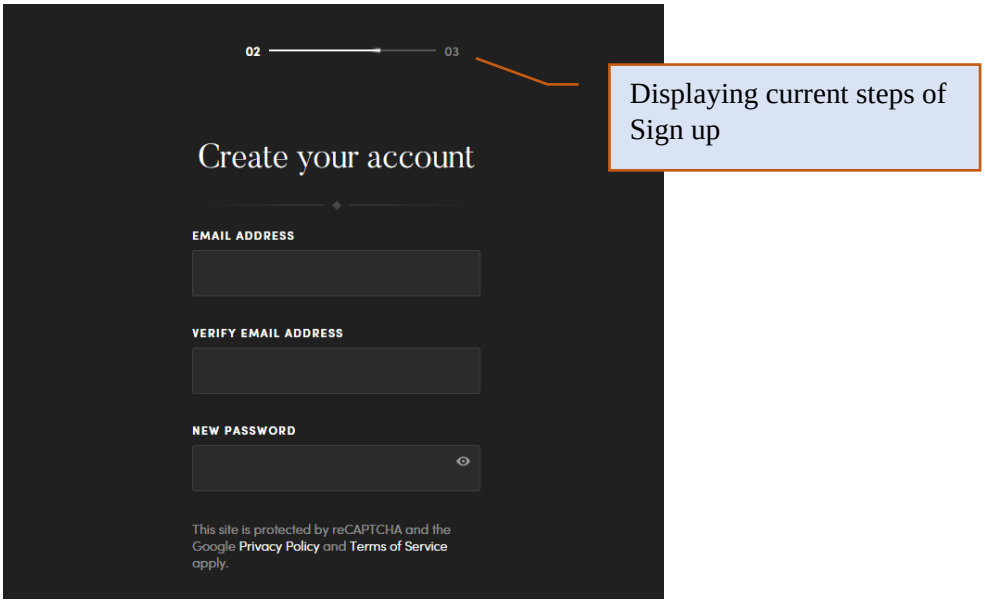

Fig 3.2.3 Source (https://my.wizardingworld.com/)

(d) Learning

In cognitive psychology, learning is a process of accepting new information such as skills and experience. Users will learn how to interact with the system and how system's functions work. To increase cognitive learning, user familiar functions would be implemented in the system such as creating music playlist, responsive slider and managing volume by dragging. For unfamiliar functions, there would be reliable instructions for users.

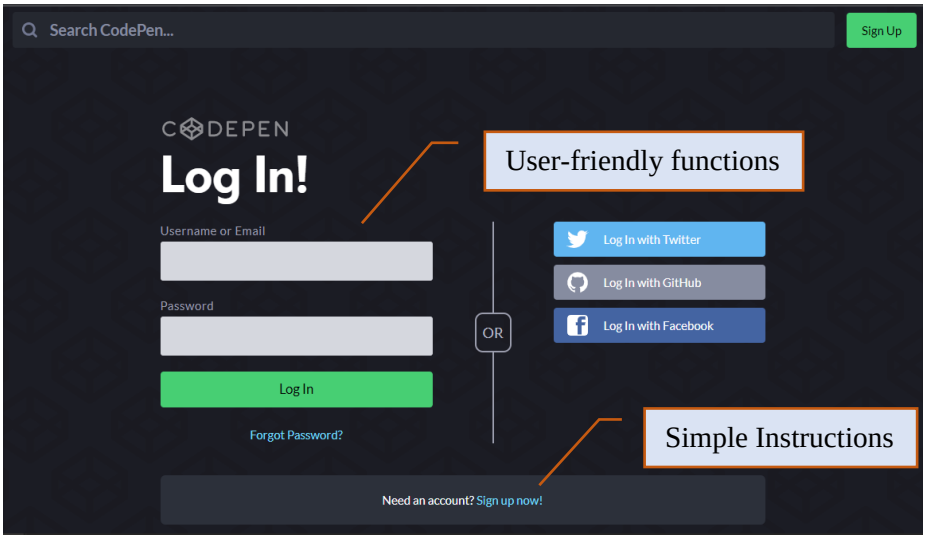

Fig 3.2.4 Source (https://codepen.io/login)

3.3 Types of interaction

During designing process, there are four main types of interactions. Those interactions types are based on common activities that users perform.

(a) Instructing

Instructing is a way of users command the system what to do. Drivers or passengers would be able to command the in-car system. Commanding can be done through clickable buttons and links as well as voice command.

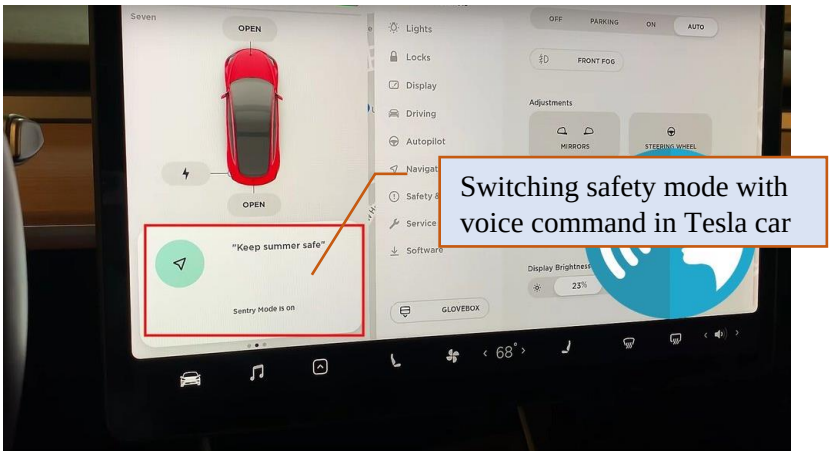

Fig 3.3.1 Source (https://www.tesmanian.com/blogs/tesmanian-blog/tesla-170-useful-voice-commands-for-owners)

(b) Conversing

The system should interact with users like a human (Anon., 2021). Showing alerts boxes when the music volume is too loud can help in conversing of in-car system. But the process of showing alert boxes should not take too long.

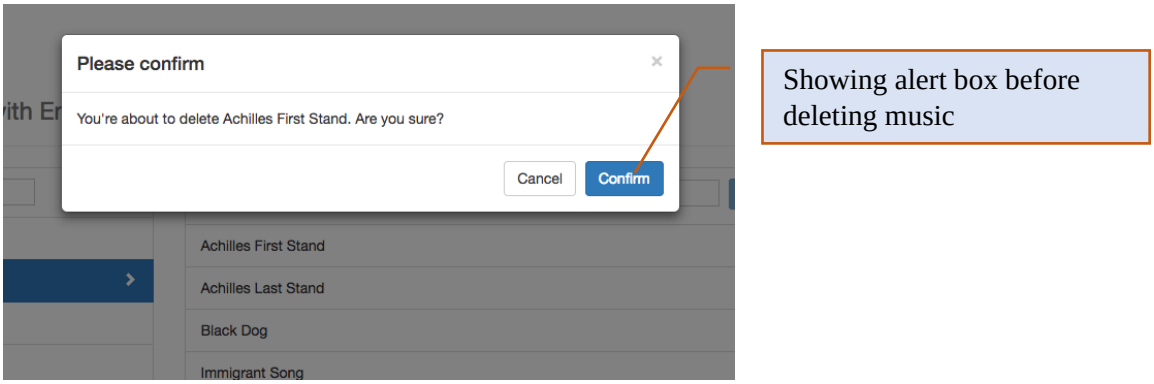

Fig 3.3.2 Source (https://balinterdi.com/blog/delete-with-confirmation-in-emberjs/)

(c) Manipulating

This interaction describes process of manipulating with objects which can be both physical and virtual. In this system, users can choose apps with a responsive slider by clicking buttons at the edge. Moreover, controlling music volume can be done with a slider by dragging and moving it.

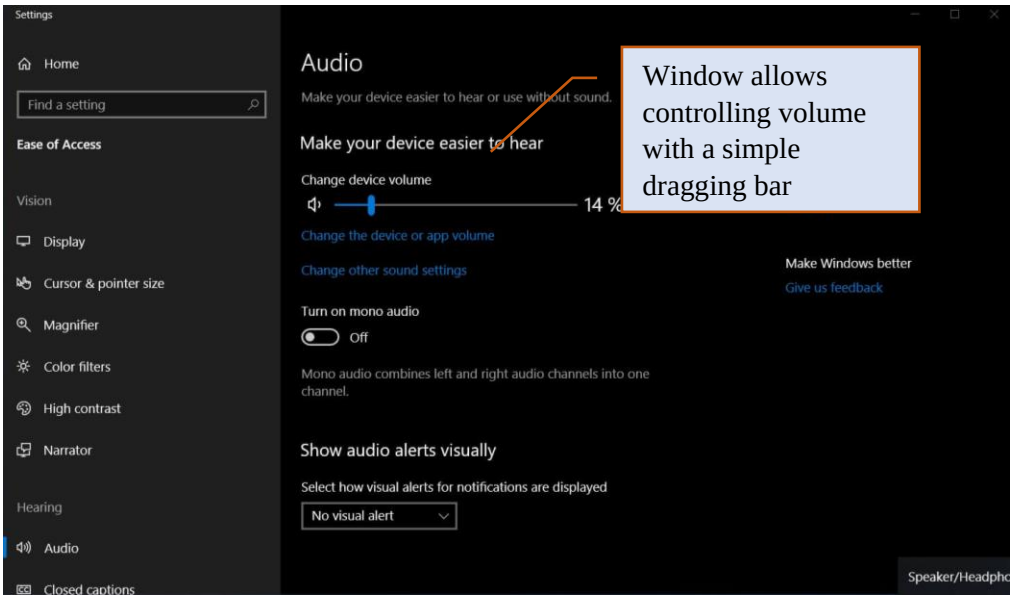

Fig 3.3.3 Source (https://www.windowslatest.com/2018/11/12/windows-10-is-reportedly-getting-a-new-volume-flyout-to-control-music/)

(d) Exploring

Exploring means involvement of search and browsing functions (Pastel, 2021). In navigation system, driver should be able to search and choose desire route. And for music library, users need to search songs and choose them. There would be listed music collections so that users can choose songs as desired.

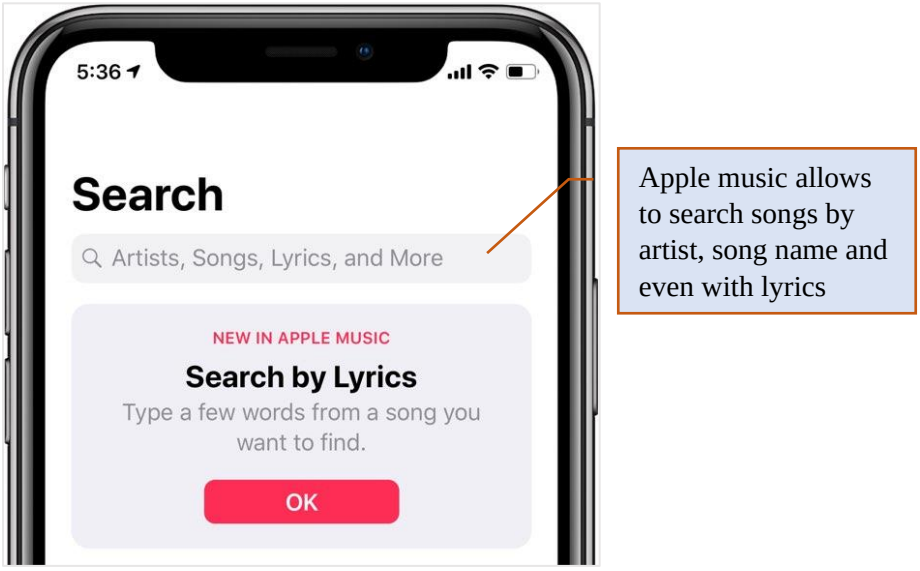

Fig 3.3.4 Source (https://www.idownloadblog.com/2018/07/31/howto-search-lyrics-apple-music/)

4. Conceptual Model

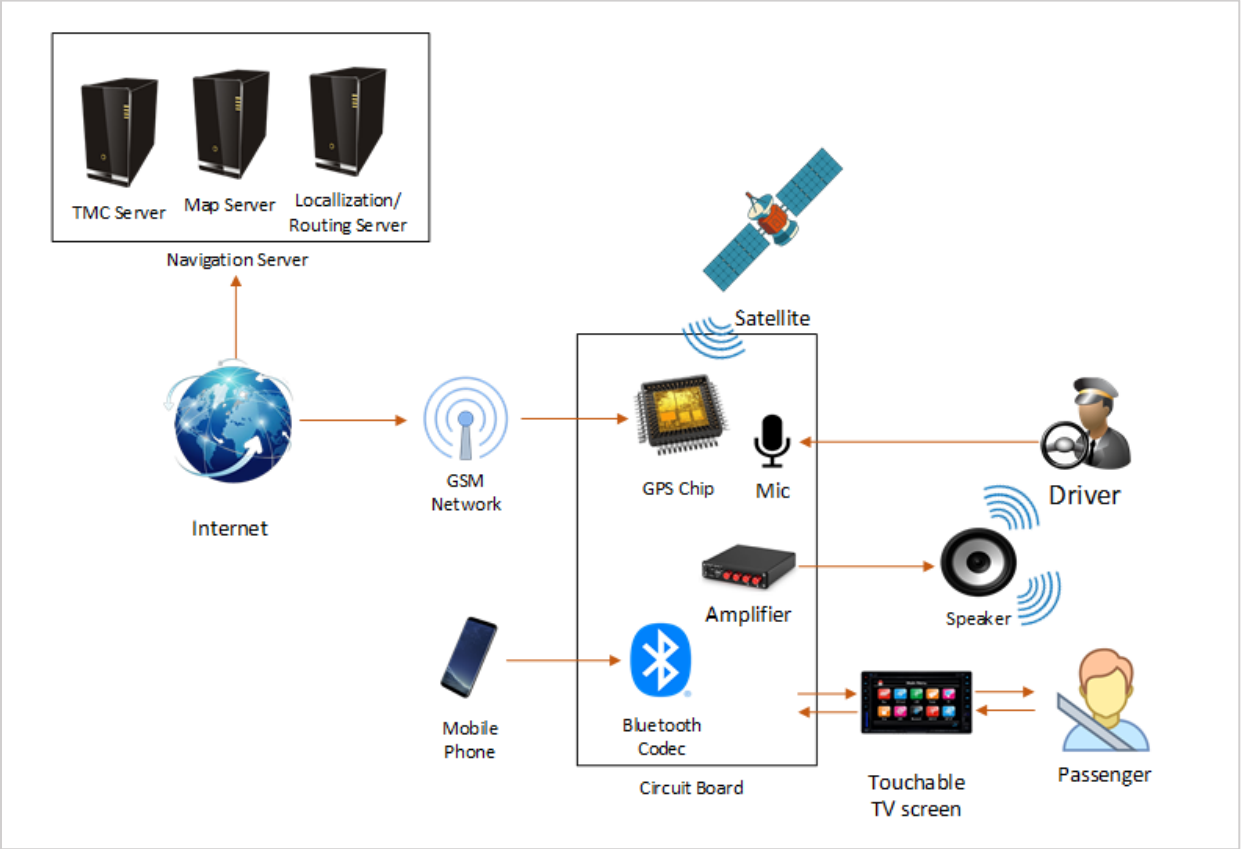

Figure 4.1 Conceptual model for in-car music library and navigation system

Description

As shown in figure 4.1, the system has devices such as touch screen, GPS chip, mic, amplifier, speaker, Bluetooth codec and mobile phone connected to the system through Bluetooth. Drivers and passengers command the system through mic or touchable interface. GPS chip connected to GSM network gathers data about traffic and map through internet receiving information from satellite and then display the traffic data. Passenger or drivers can access music library of mobile phone connected with Bluetooth then sound will be played with a speaker with the help of an amplifier.

5. Requirements Specification

5.1 Design elements

While creating prototypes for in-car system, visual elements such as icons and images will be applied. Most of the survey participants like using icons in the system. Location arrow icons is suitable to refer navigation and map maker icon will be used to show location since users can easily understand those icons. Other relevant icons such as sound, Bluetooth, music note, play icons will be applied in suitable places. Images will be applied in showing traffic signs and in background.

5.2 Layout

The dimension of the system's interface will be 1280px in width and 800px in high (the same dimensions as android tablet) because most of in-car TV are in that size and users will feel comfortable with that dimensions. At index page, one-third of the screen would display time, route and other details with multiple widgets. Others two-third of the screen will display app slider. Music page and Bluetooth page will have similar interface. But in navigation page, the whole screen would show the map because users need to focus on the route.

5.3 Font

According to the survey result, "Verdana" font-family with the font size of 30 will be used. To make the system look unclutter, italic font will not be applied in the system. Dark background with second color of blue will be apply in the design in the opinion of survey participants. Moreover, there would be an image in the background of screen instead of having solid black background.

5.4 Functional and non-functional requirements

Functional requirements	Non-functional requirements
• Choosing app with a responsive slider • Linking to navigation page, music library, Bluetooth page • Choosing location in navigation page • Choosing music from music library • Playing and pausing music • Controlling music volume with a slider • Choosing devices to connect Bluetooth • Disconnecting Bluetooth devices • Toggling dark and light theme	• Displaying not more than 7 items by applying Miller's magical numbers • Alert boxes and reminders • Always displaying current status of Bluetooth, destination and music • Making user-friendly interface

Design Solution

6. Screen Design

In this project of creating prototypes, Axure Software is used. Design elements and layouts chosen for the prototypes is shown below

Layouts, fonts and color contrast

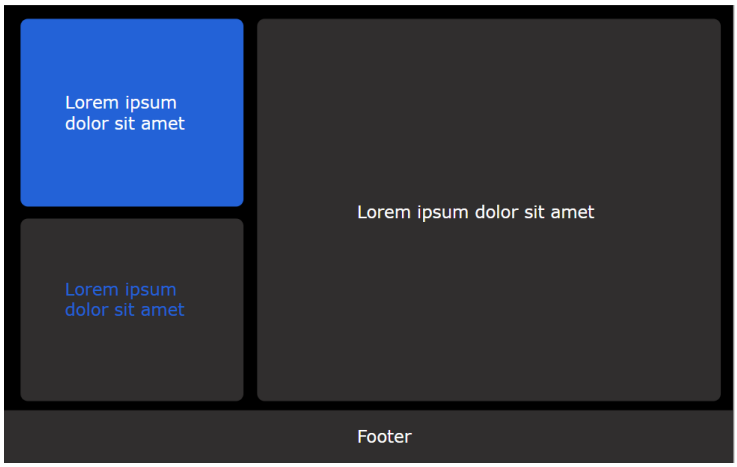

Fig.6.1

Design Elements

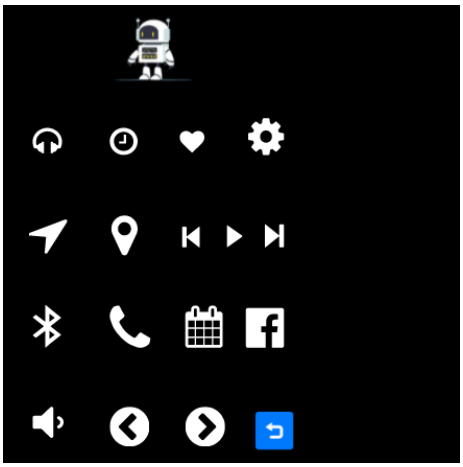

Fig.6.2

Mid-fidelity prototypes of in car navigation and music library system are shown below.

6.1 Welcome Screen

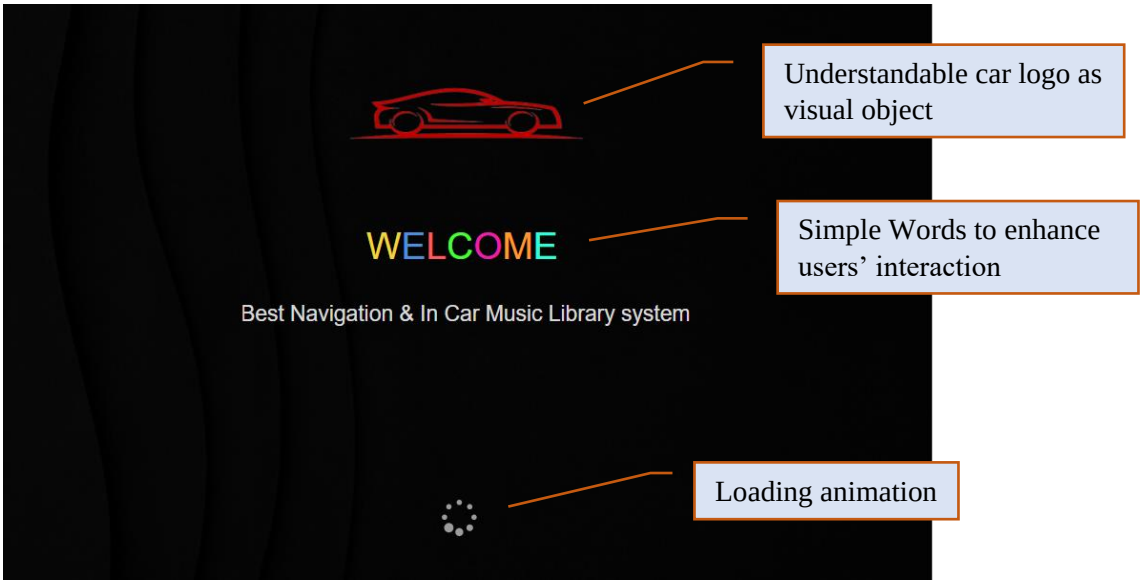

Fig 6.1.1

6.2 Dashboard page

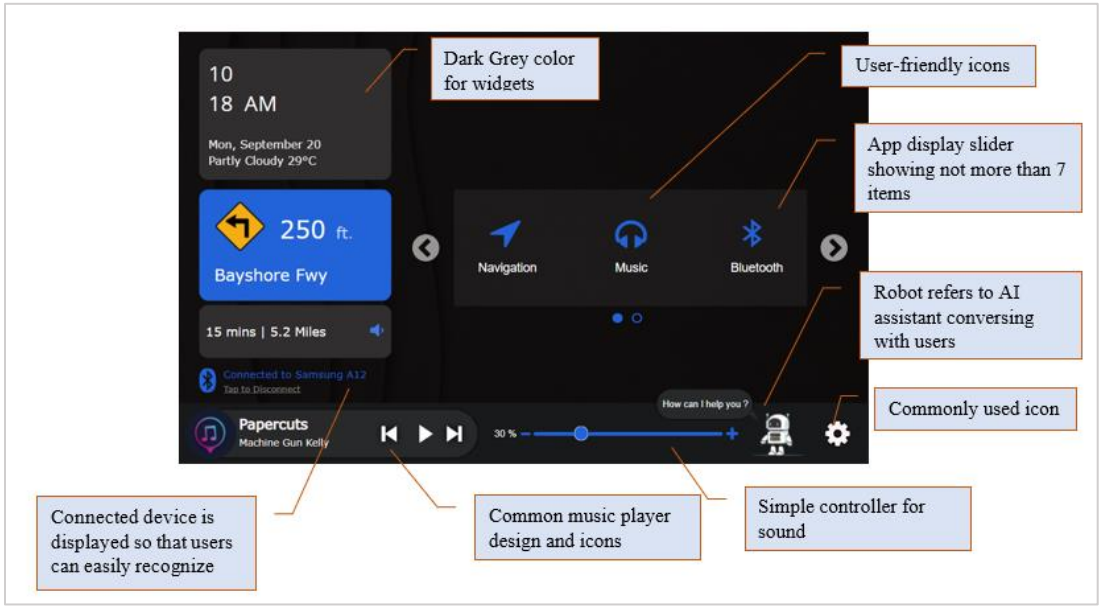

Fig 6.2.1 Dashboard page with normal sound level

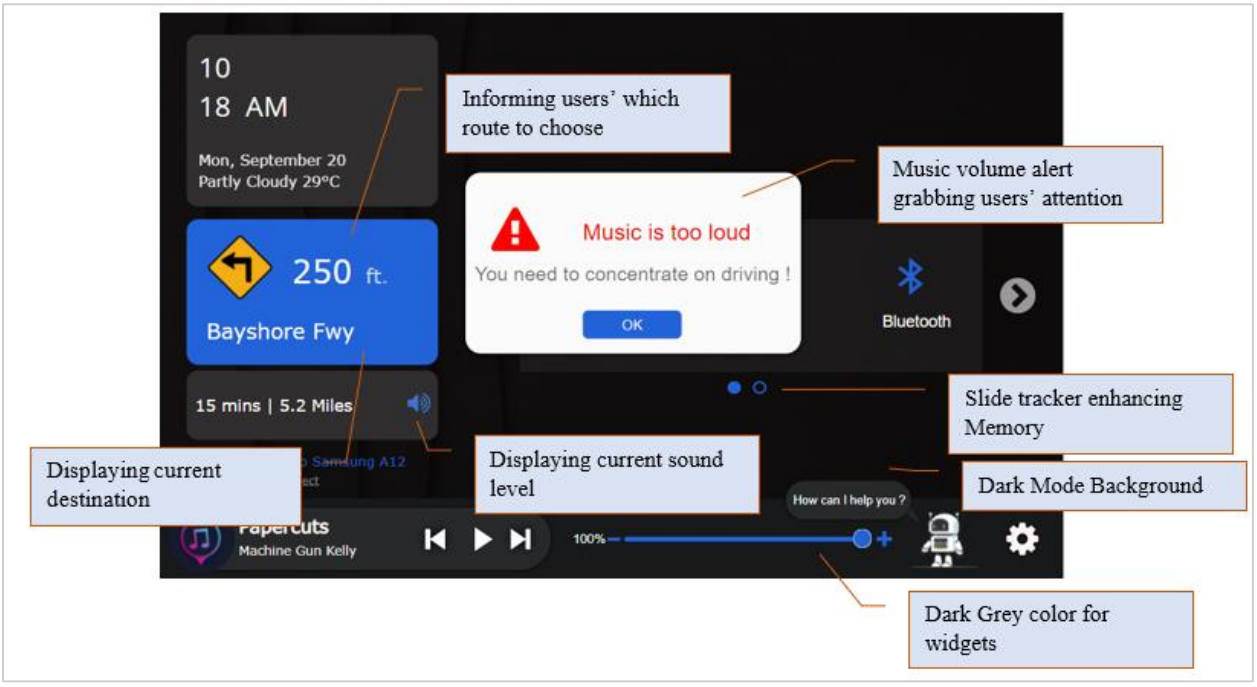

Fig 6.2.2 Dashboard page with high sound level

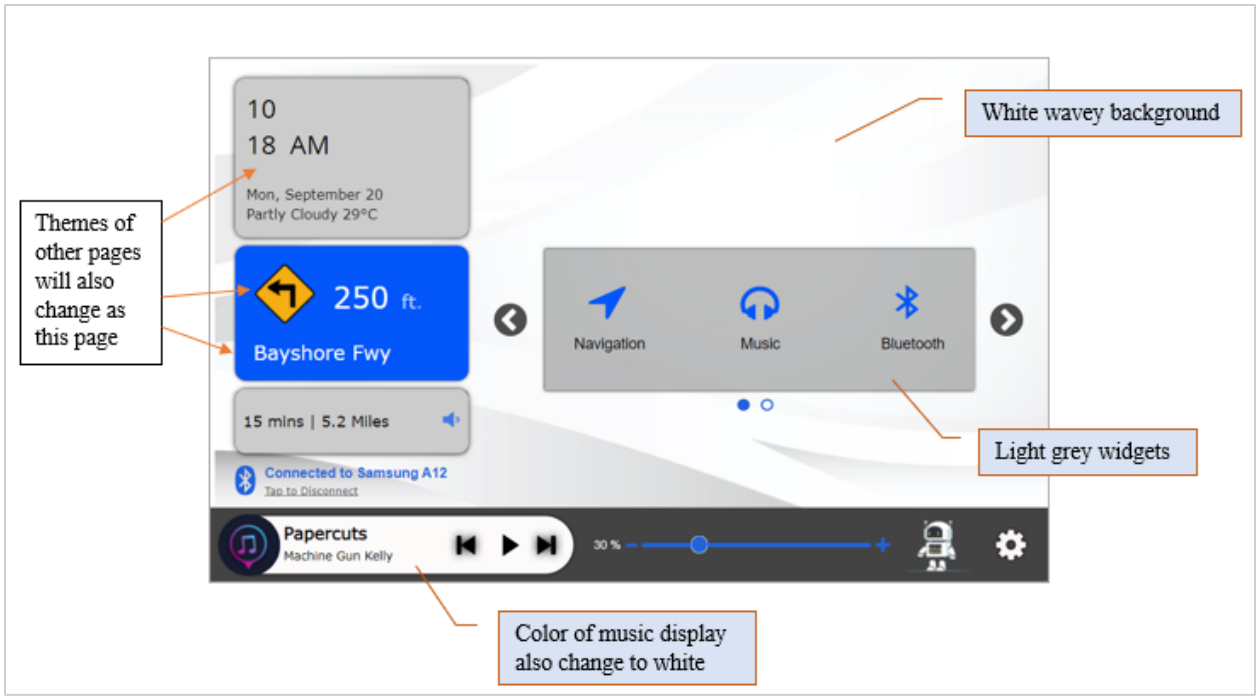

Fig 6.2.3 Example of Dashboard page in light theme

6.3 Navigation page

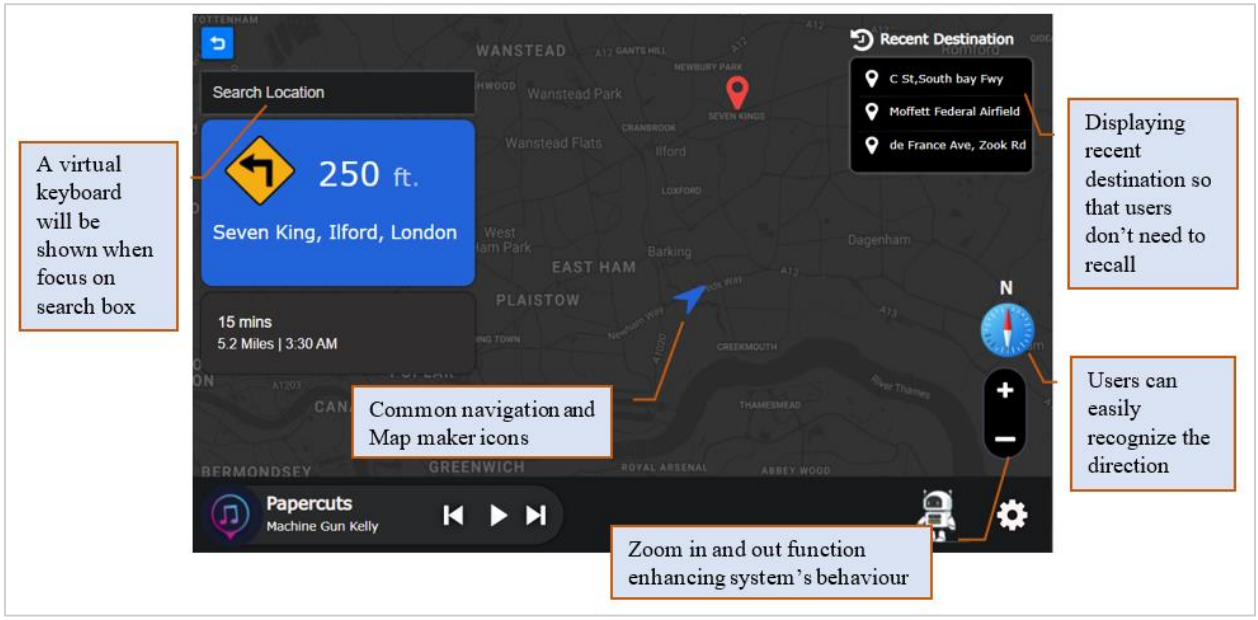

Fig 6.3.1

6.4 Music Library page

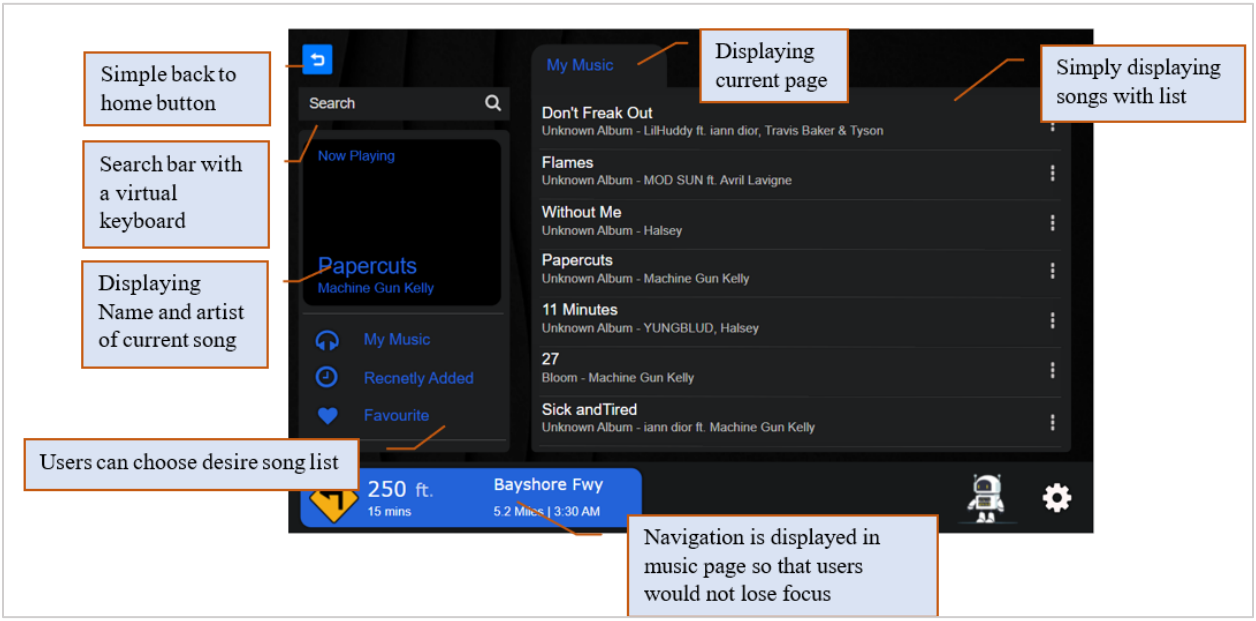

Fig 6.4.1

6.5 Bluetooth setting page

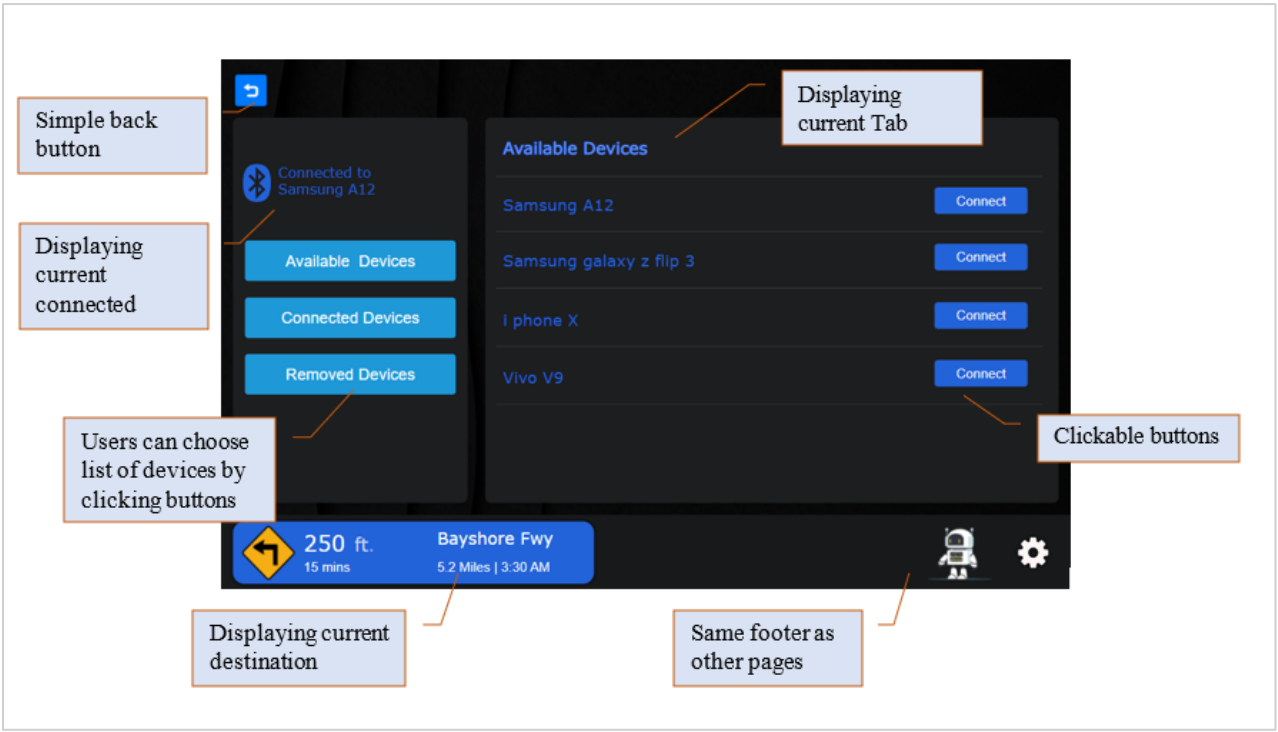

Fig 6.5.1

6.6 Setting page

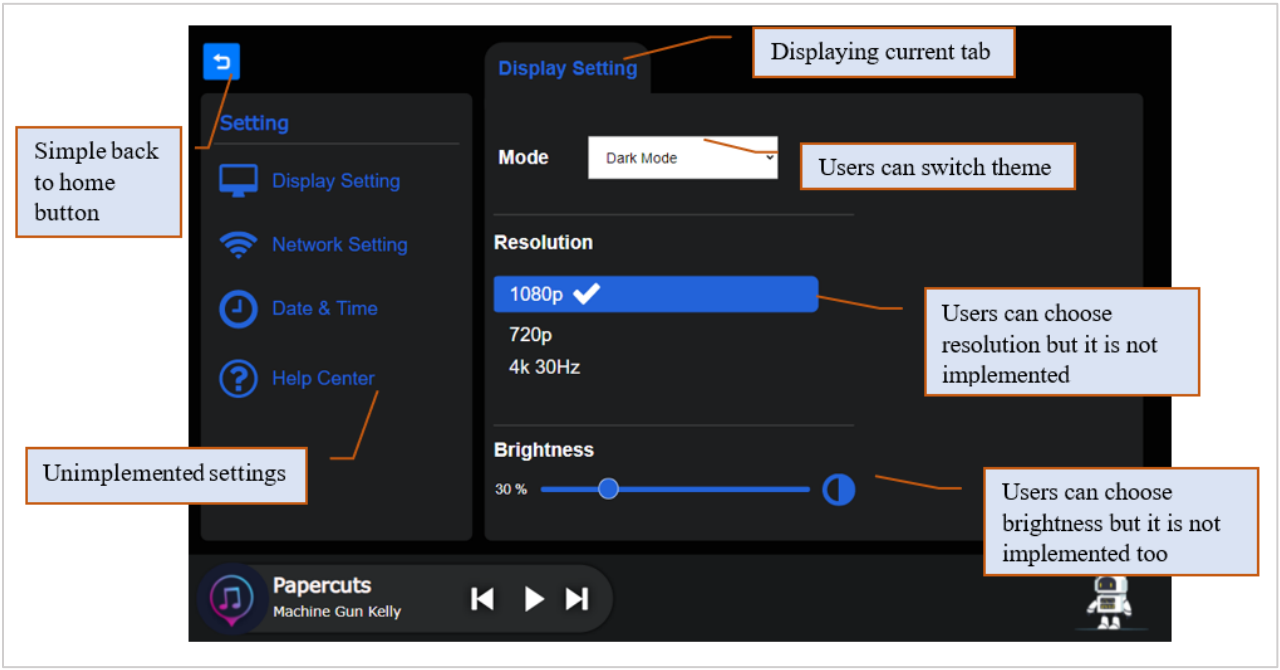

Fig 6.6.1

6.7 Example pages in iPad size

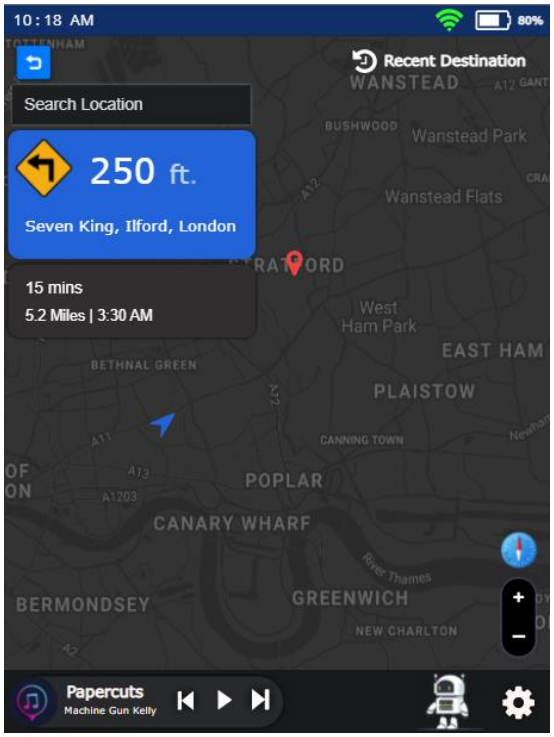

Fig 6.7.1 Navigation page in iPad size

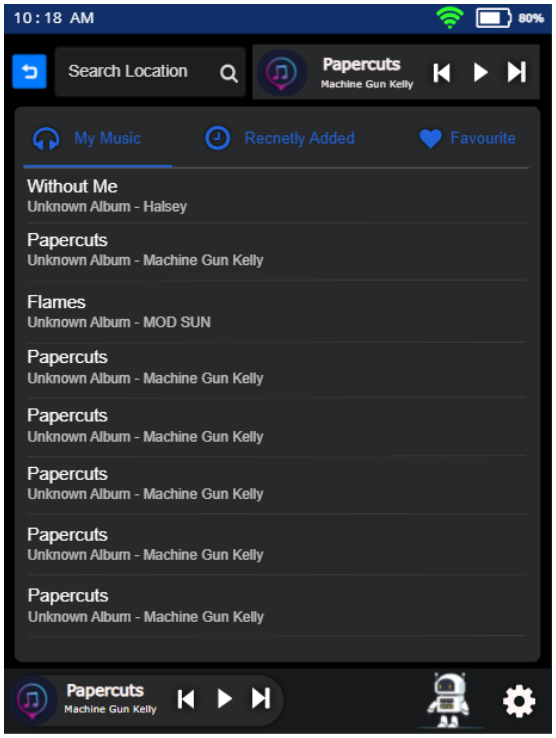

Fig 6.7.2 Music library page in iPad size

Evaluation Against Requirements

7. Evaluation

7.1 Heuristic Evaluation

Visibility of system status

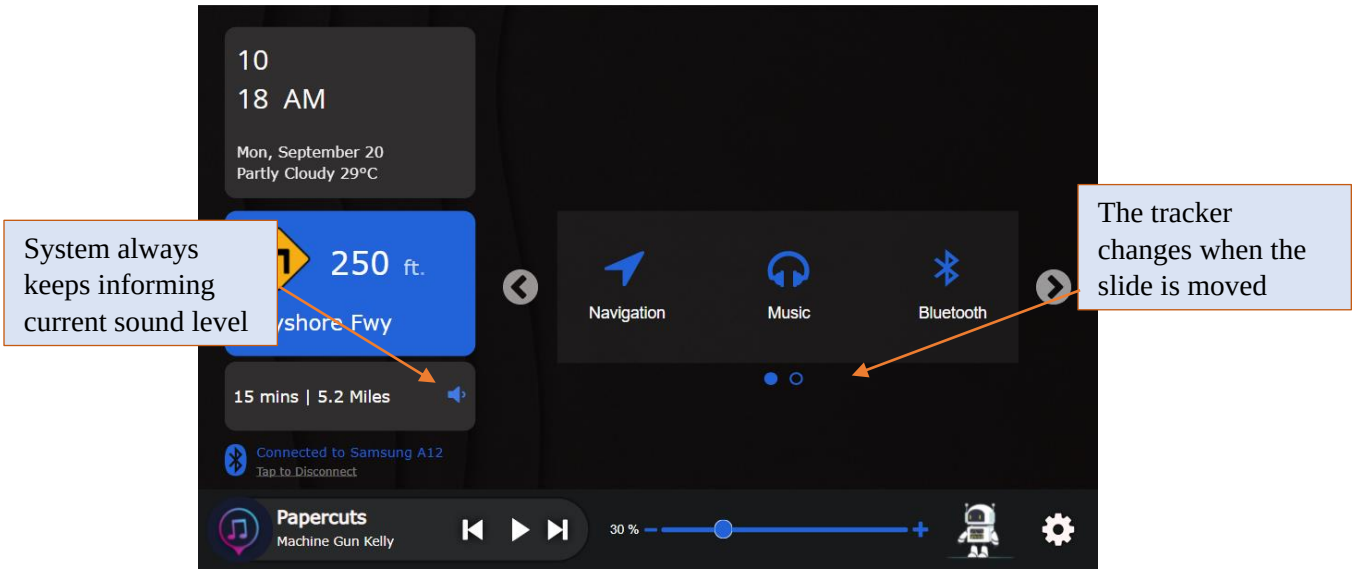

Fig 7.1.1

Description : App slider has a tracker which show current slide and current sound level is always displaying with icons.

Match between system and real world

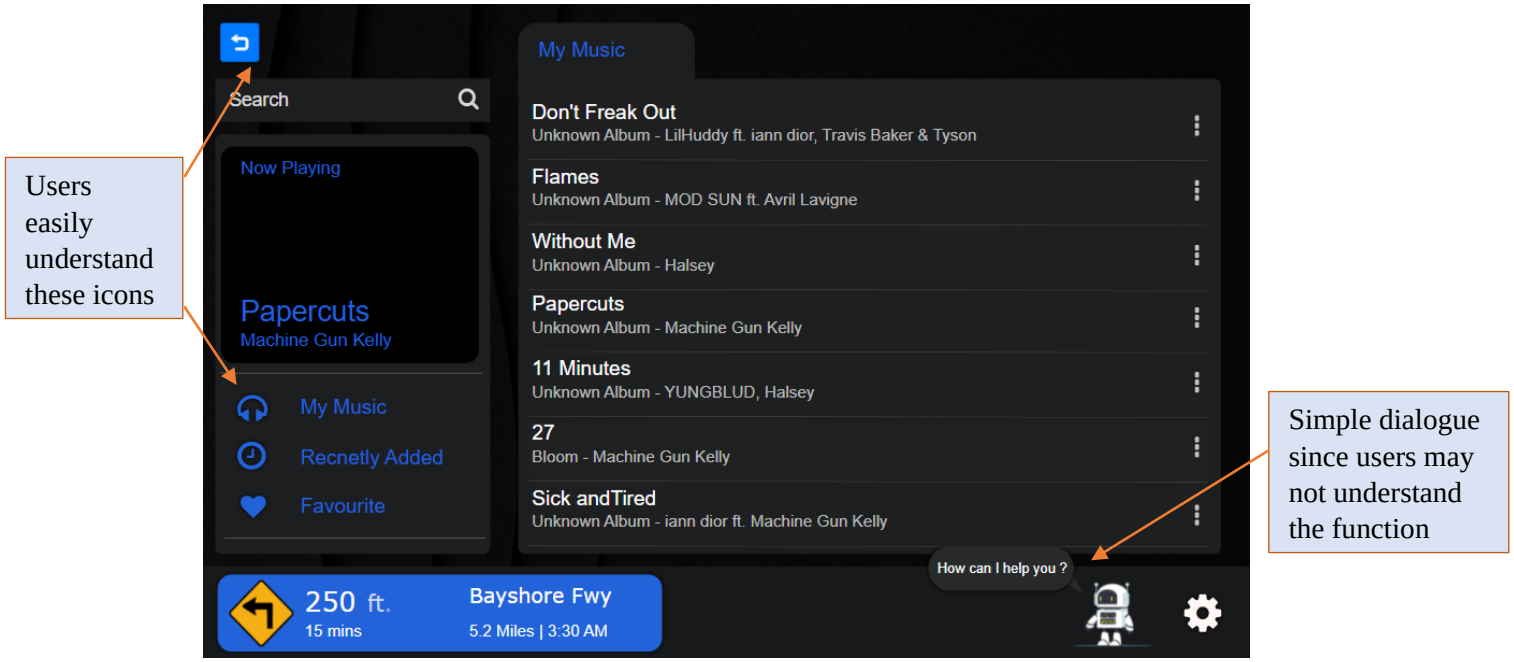

Fig 7.1.2

Description: The system uses icons the images which users can easily understand. There are some instructions for the icons and functions that users cannot easily understand.

Aesthetic and minimalist design

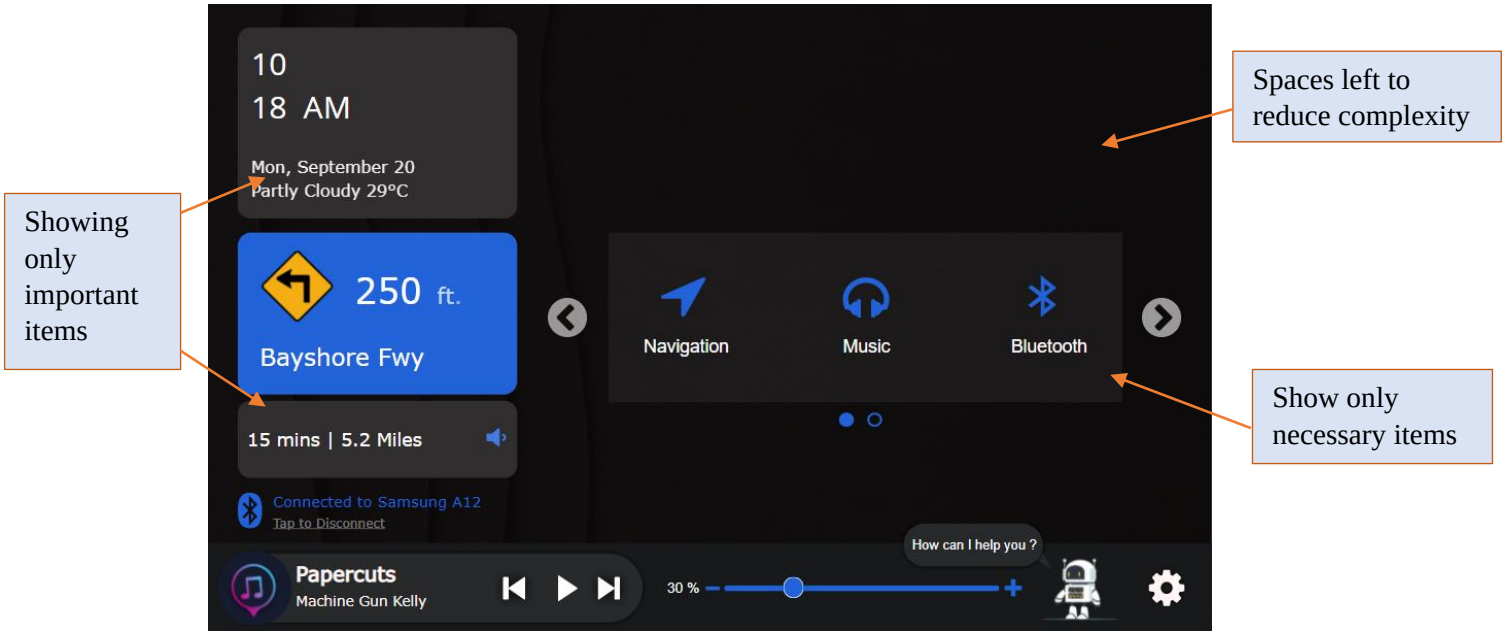

Fig 7.1.3

Description: All the pages are only showing necessary items in order to avoid cluttering the interface.

Consistency and standard

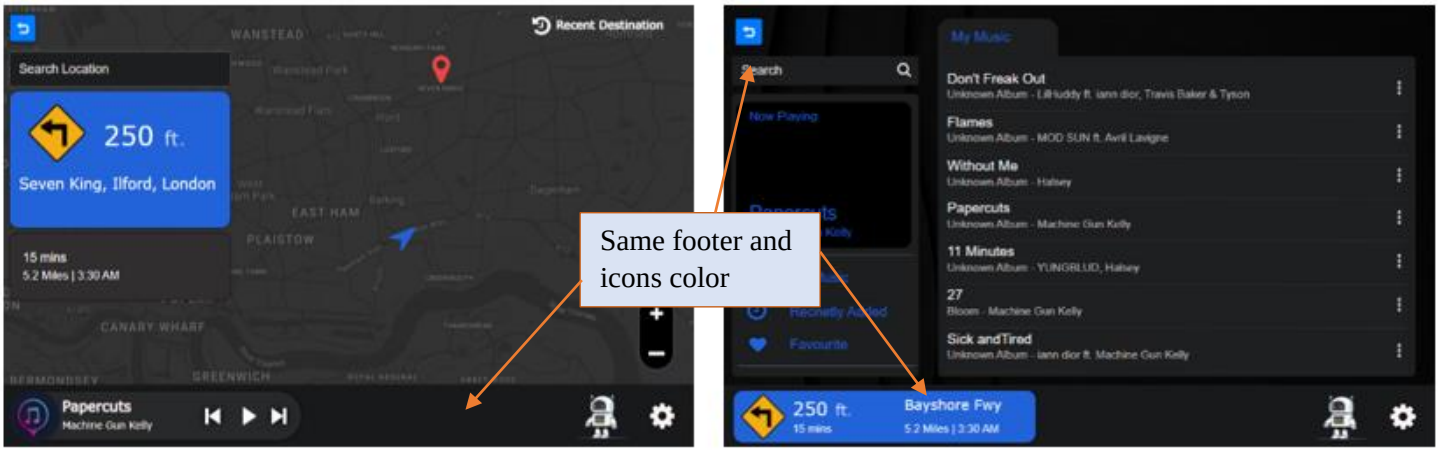

Fig 7.1.4 Consistency between Navigation and music page

Description: All the pages have same icon color, font-family and size, footer and background color.

Flexibility and efficiency of use

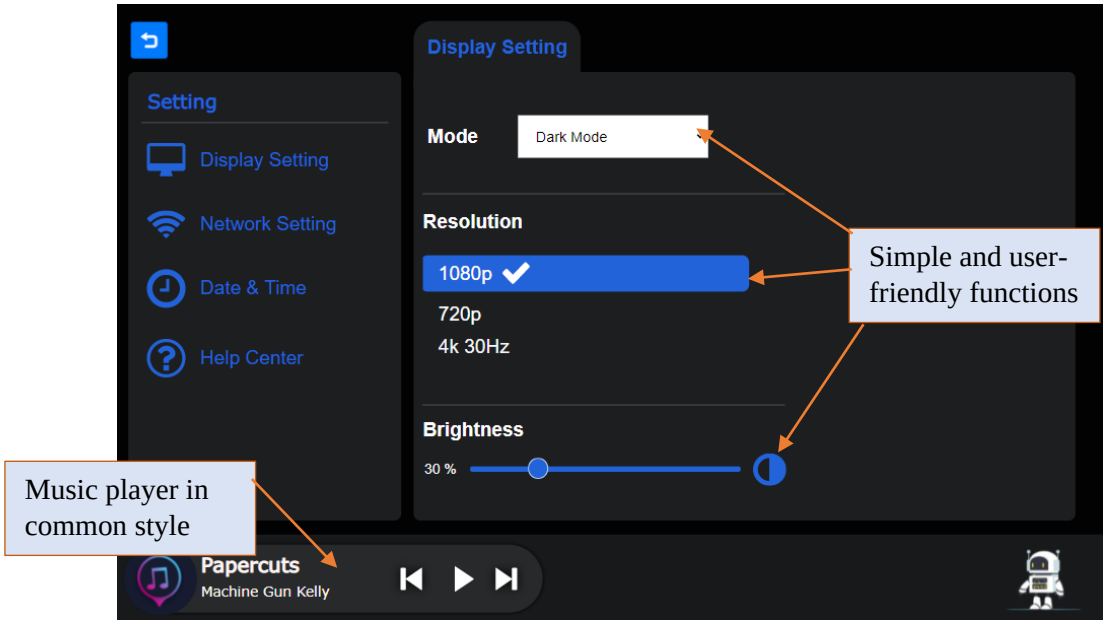

Fig 7.1.5

Description: Users can easily navigate between pages and functions are simple so that non-technical users can easily understand.

Users control and freedom

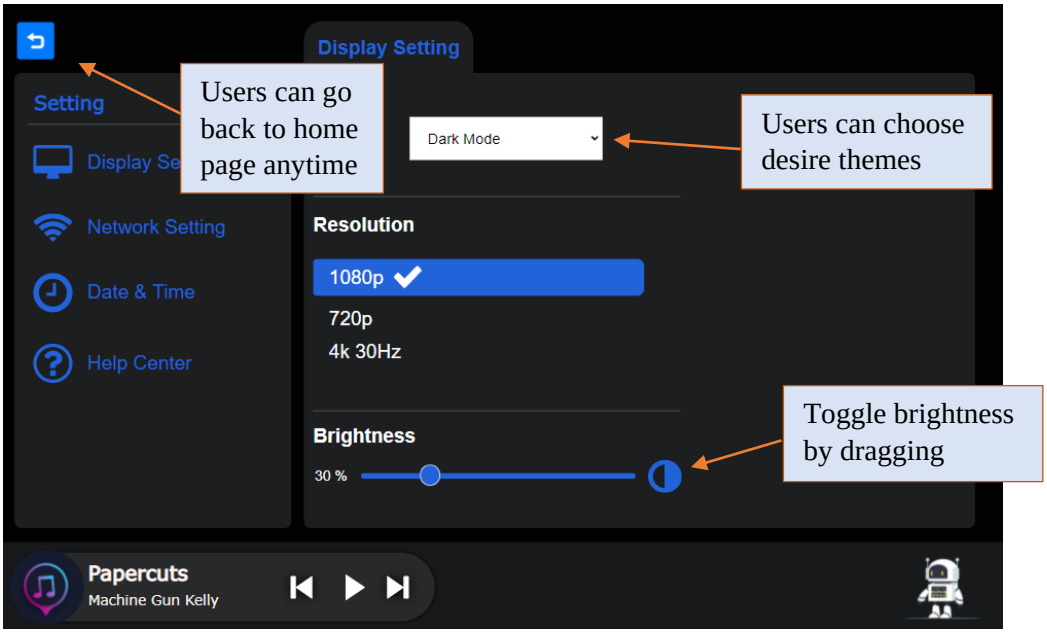

Fig 7.1.6

Description: Every page has a button to go back dashboard page and users can toggle their desire theme.

Recognition rather than recall

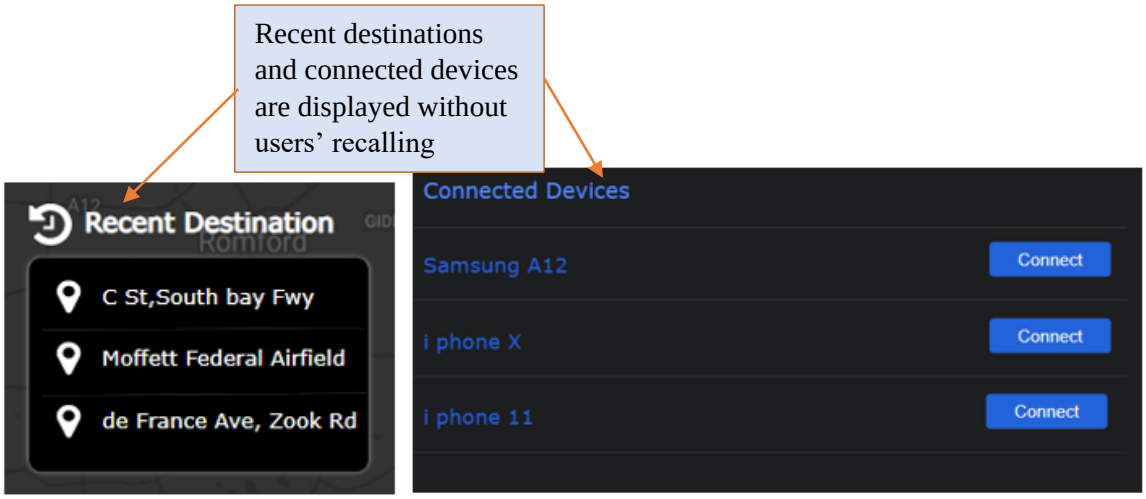

Fig 7.1.7

Descriptions: Recent destination, recently added music and connected devices are displayed in respective pages so that users' do not need to recall

7.2 Survey on completed prototypes

As mentioned above, survey can only be done through google forms according to Covid 19 pandemic. People in different ages group of 15 to 45 will be participants in this survey. Showing the system to the survey participants will be done by hosting and linking survey participants. Survey questions on completed prototypes will have two parts: Usability questions and design questions.

Usability questions would include

- Is app choosing slider responsive and work well ?
- Is scroll bar for music volume responsive and work well ?
- Do buttons in music player work well?
- Is links and buttons in navigation system work well?
- Is there any button or link that doesn't working?
- Is there any complexity in using functions of system?
- Is the UI of the system friendly and comfortable?
- Is it take too much time for using the system?

Design questions would include

- Is color contrast of the system comfortable?
- Are icon usages understandable?
- Is font-family and size applied in the system comfortable?
- Are the layouts used in the system comfortable?
- Please suggest on the improvement of system interface.

After survey, iterations will be done according to users' feedbacks. Designs and functions which do not work well will be maintained according to survey results.

8. Conclusion

8.1 Difficulties

There are a lot of difficulties found during this project. The main difficulties would be COVID19 pandemic where people in almost every city and every town are home-quarantined. So, researches methods such as interview and questionnaire are not possible to do and survey had to be done online through google forms. According to Myanmar's political problems, there were some internet and electricity cut off. Moreover, using Axure software is not easy since it is a new and unfamiliar software. It was planned to apply an animation in index page to show if music is playing or not. But animation could not be stopped when music is paused. So, that animation was removed. According to Axure's limitations, voice command is not able to implement. Other small difficulties would be finding suitable icons and images to use in the system because there was not enough source.

8.2 Lesson Learnt

From this project, a lot of experience and knowledge of a good user interface are got. Researches had to be made about human's cognitive psychology and it is quite interesting. Dimensions of interaction design are found very useful and these theories can be applied in other upcoming projects. It is very satisfying when the researched theories are actually applied in the design. Using Axure software had to be learnt online by watching tutorials on YouTube and Axure is a very useful tool. Moreover, knowledge of using icons, visual elements and suitable colors is learnt.

8.3 Future Development

If there is more time, the system would have more functions such as interactive map which can be dragged and choose desire destination. Current map implemented in the prototype is not interactive. Some more UI setting such as changing font-style and font sizes can be created. Search functions can also be implemented in navigation and music library with a virtual keyboard since current keyboards applied in the system do not actually work.

8.4 Summary

To be summarized, the project of creating prototype for in-car system can said to be successful. Researching theories to develop interaction between human and the system is very interesting and those theories are quite reliable. A lot of knowledge is got from this project and difficulties become experience as well as lessons learnt. The system could have more functions if there is more time.

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Appendices

Appendix A : Survey Questions

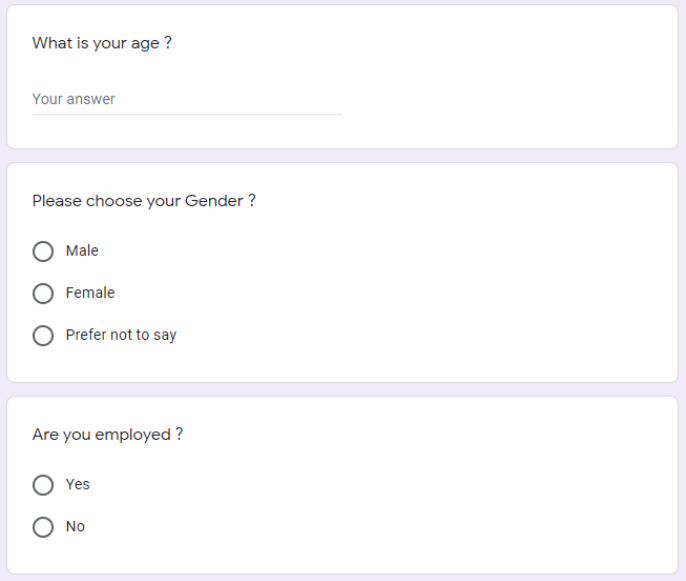

Fig 2.2.1

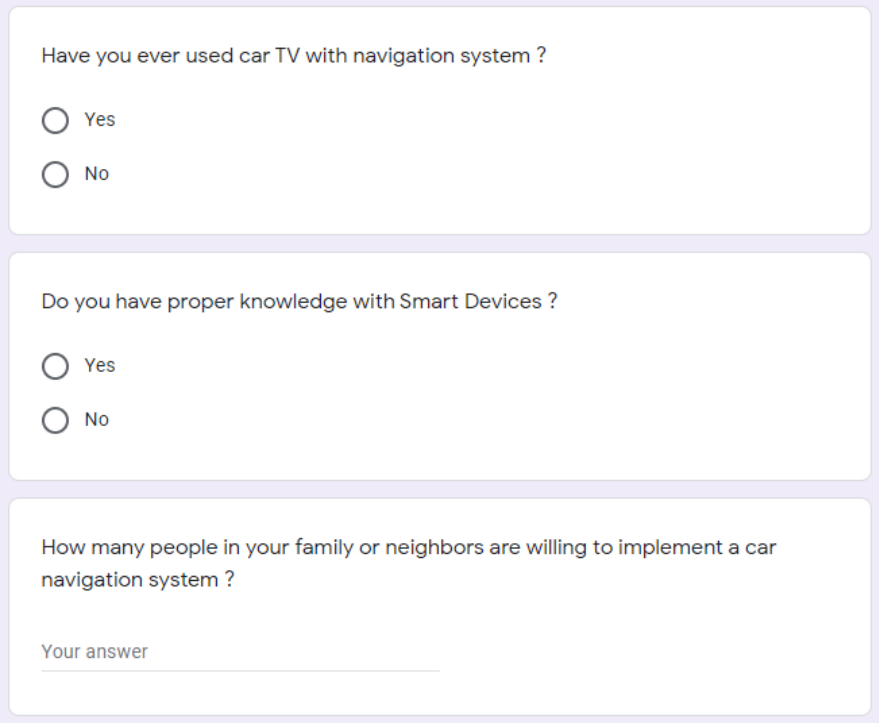

Fig 2.2.2

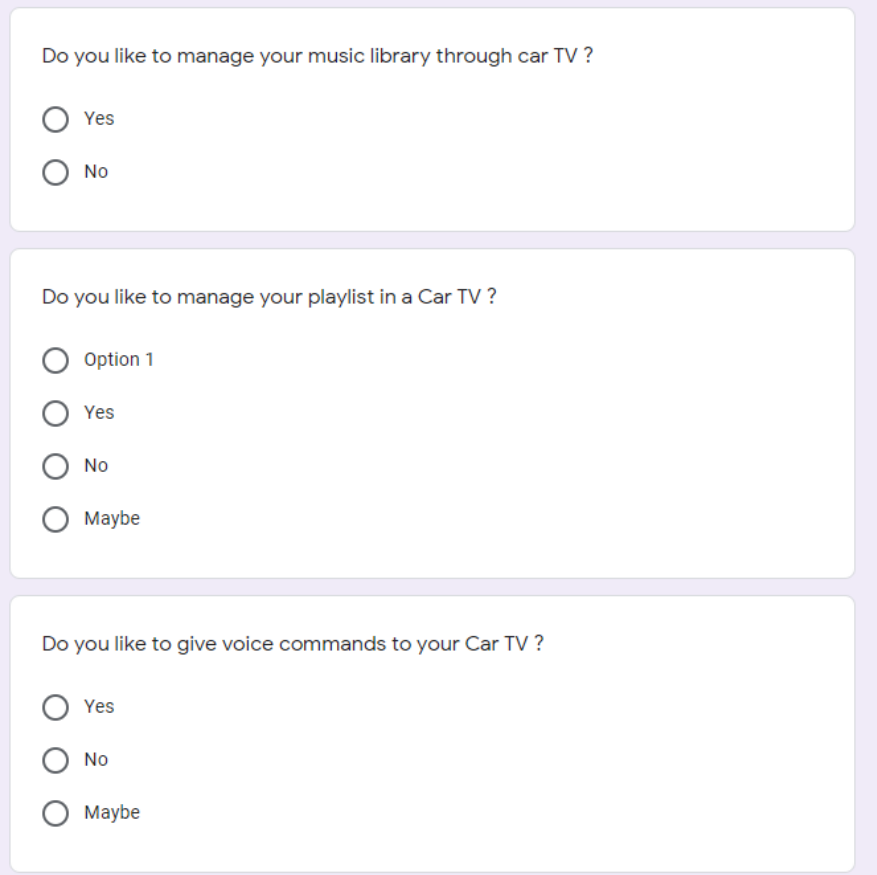

Fig 2.2.3

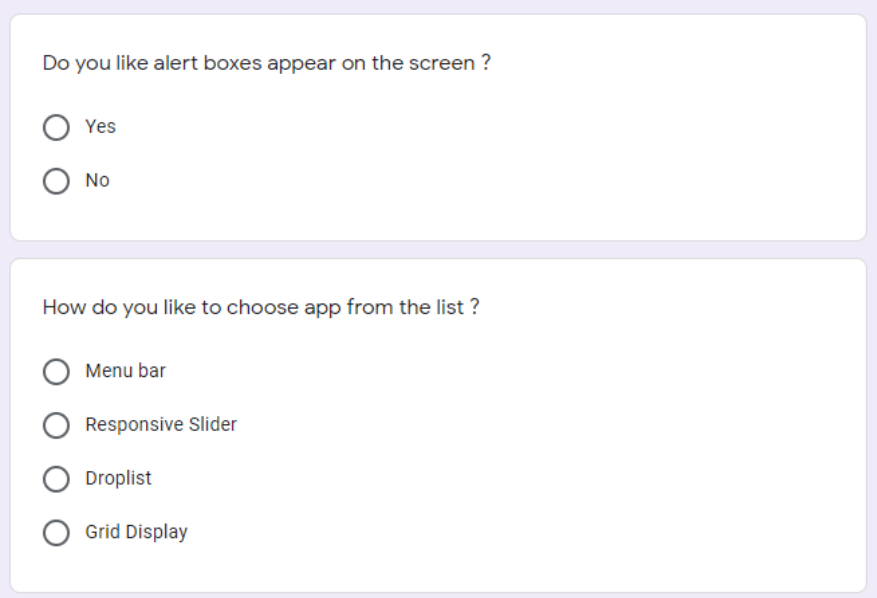

Fig 2.2.4

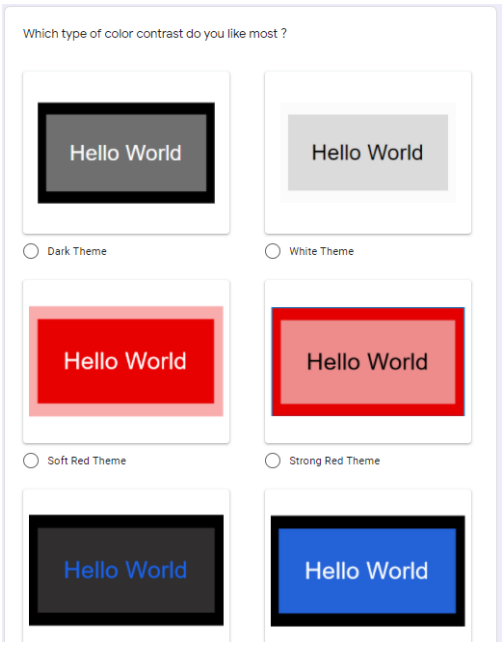

Fig 2.2.5

Fig 2.2.6

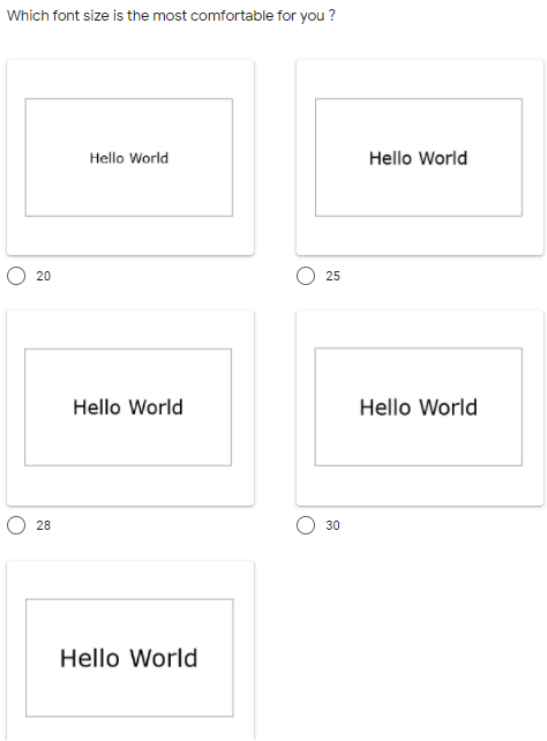

Fig 2.2.7

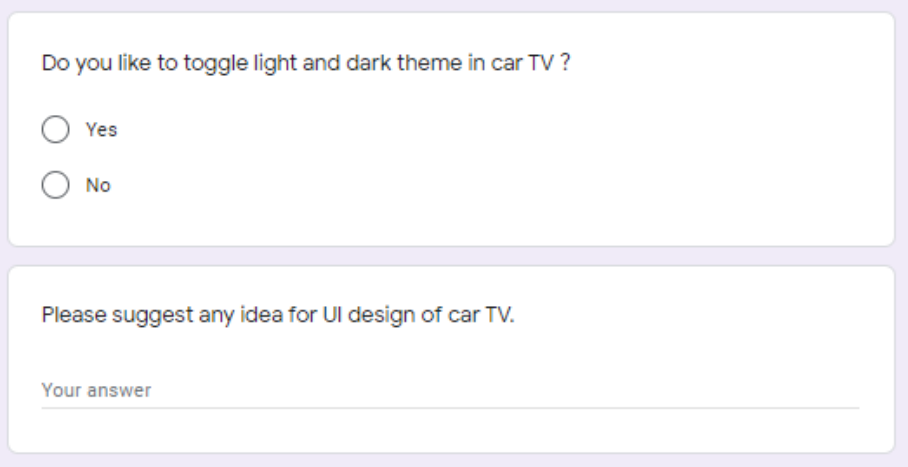

Fig 2.2.8

Appendix B: Survey Results

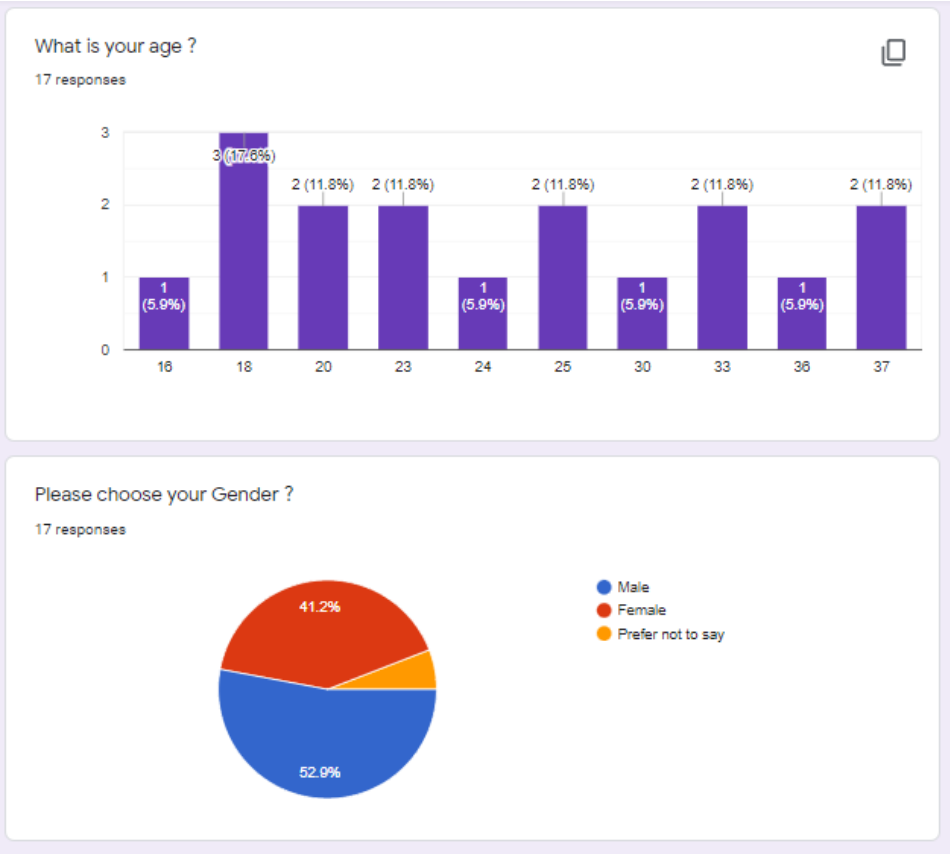

Fig 2.3.4

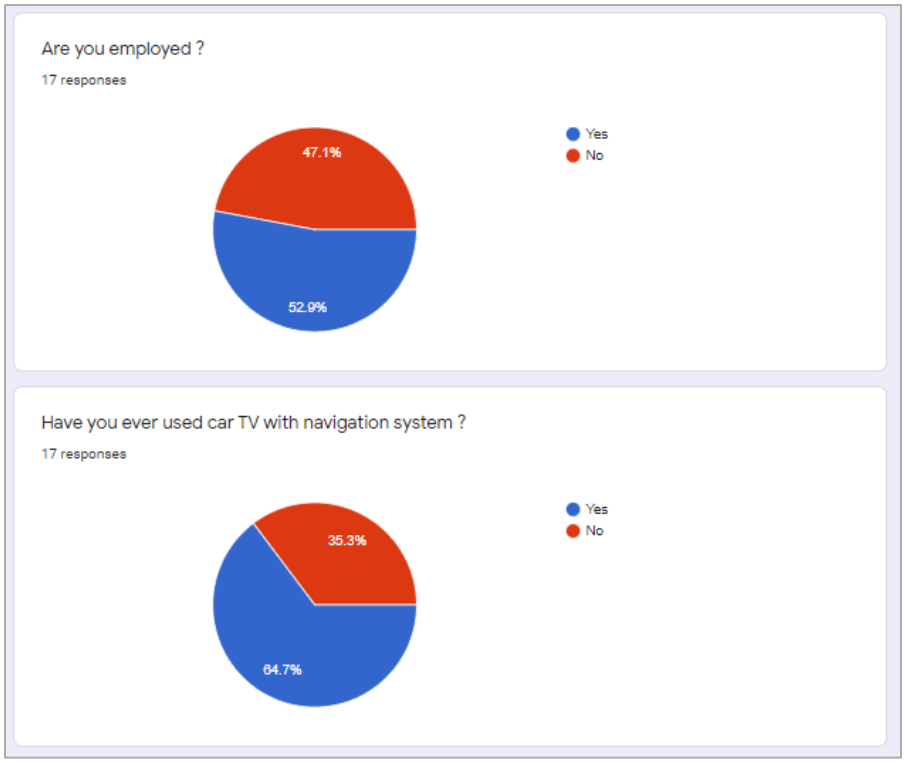
Are you employed ?
17 responses
47.1%
52.9%
Yes
No
Have you ever used car TV with navigation system ?
17 responses
35.3%
64.7%
Yes
No

Fig 2.3.5

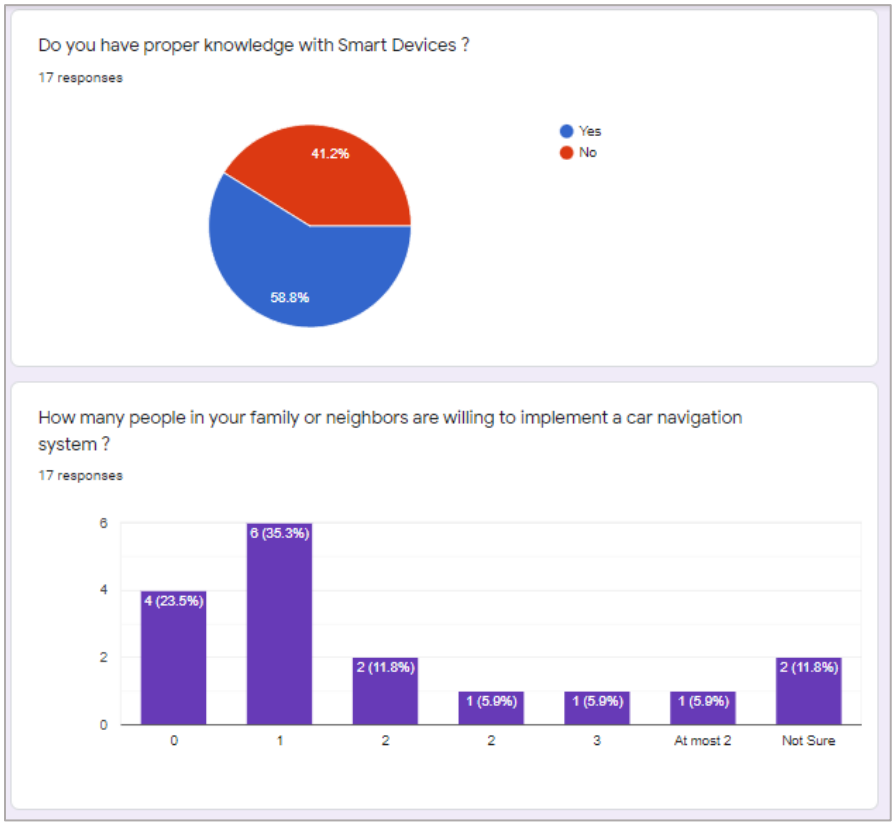
Do you have proper knowledge with Smart Devices ?
17 responses
41.2%
58.8%
Yes
No
How many people in your family or neighbors are willing to implement a car navigation system ?
17 responses
6
4
2
0
4 (23.5%)
6 (35.3%)
2 (11.8%)
1 (5.9%)
1 (5.9%)
1 (5.9%)
2 (11.8%)
0
1
2
2
3
At most 2
Not Sure

Fig 2.3.6

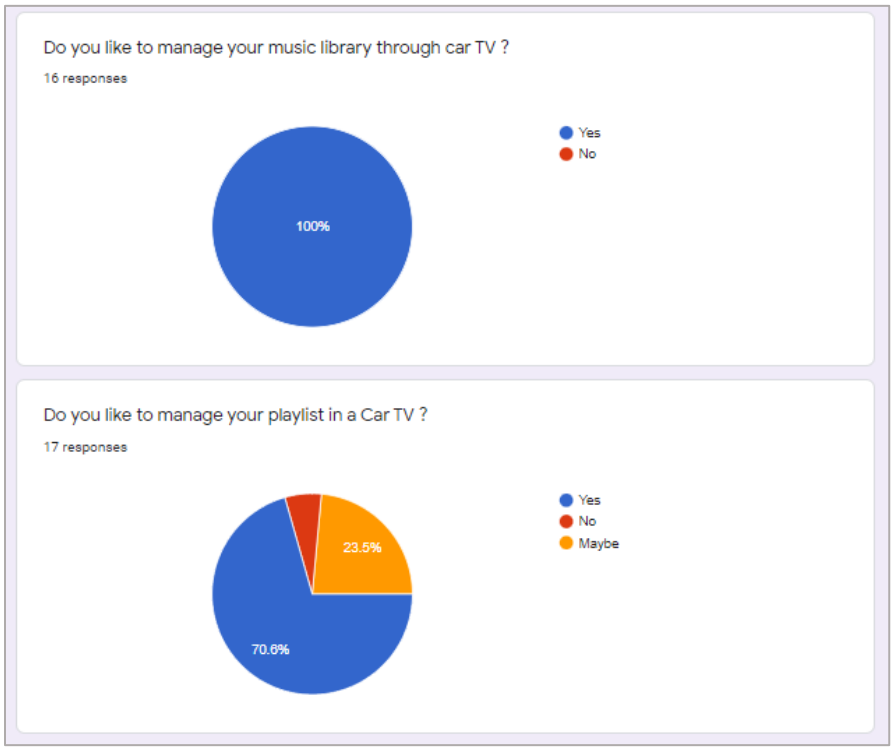

Fig 2.3.7

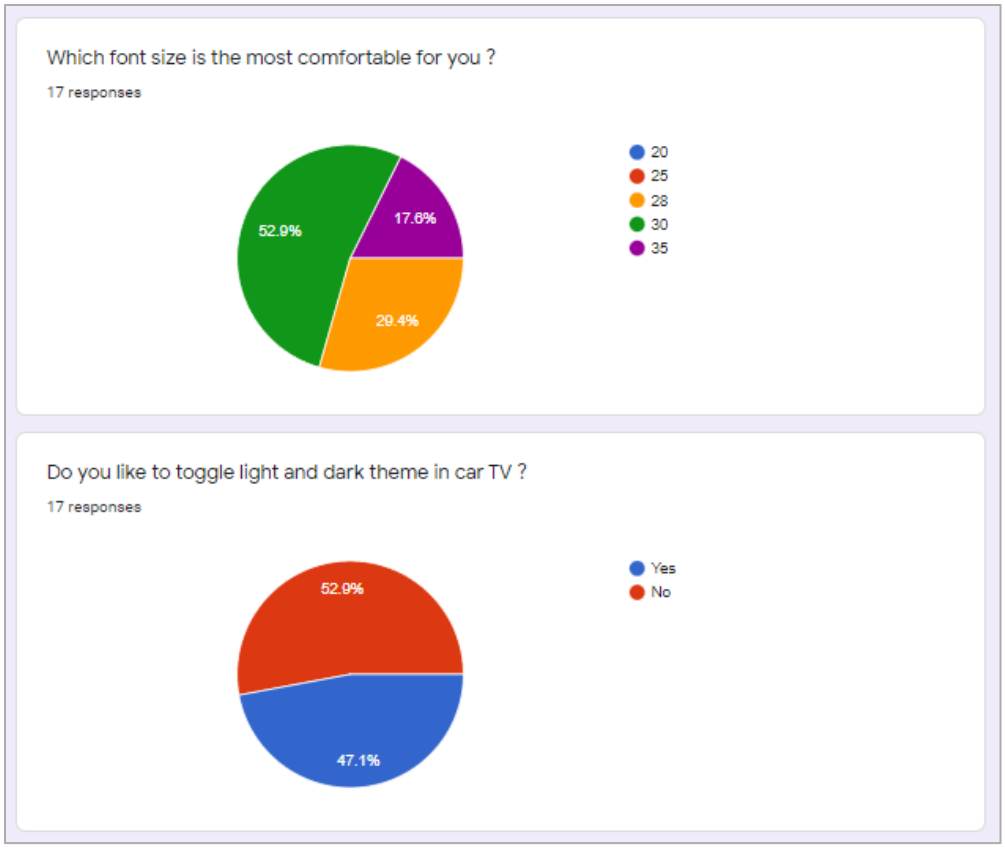

Fig 2.3.8

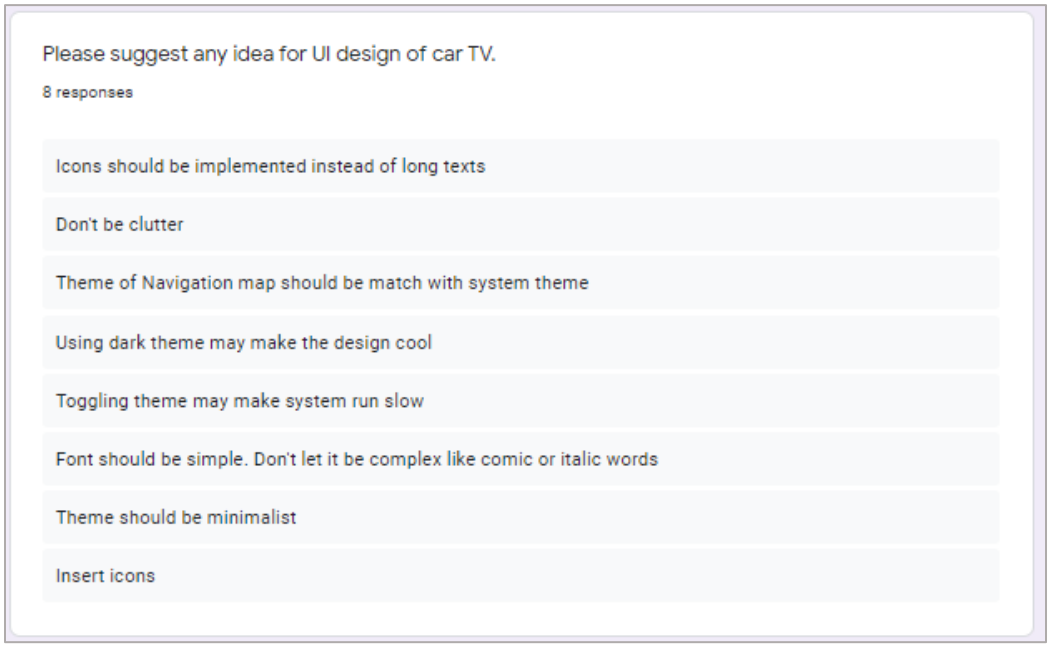

Fig 2.3.9